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The Semantics of Temporal Indexicals

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Declaration

I declare that this thesis has been composed by myself and that the research reported therein has been conducted by myself unless otherwise indicated.

Jon Oberlander

Edinburgh, 1st April 1987

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First, I must record my gratitude to my supervisors, Barry Richards and David McCarty. Barry Richards has given both guidance and consistently constructive criticism; his influence in what follows should be obvious. David McCarty has provided considerable technical assistance, particularly with the establishment of the results reported in Chapter 6. I've enjoyed working with them both.

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Abstract

The thesis investigates the formal semantics of temporal indexical expressions in English. Examples of such expressions include *now*, *tomorrow* and *last year*.

In the past, research has concentrated on instances of such expressions which have two major properties. These indexicals are sensitive to extralinguistic context, and while they do possess descriptive meaning, that meaning does not appear within the propositions which correspond to utterances of the sentences which contain the indexicals.

The thesis argues that this line of research has neglected a significant body of natural language evidence in which indexicals display rather different behaviour. We term indexicals from the first group unbound, and indexicals from the second group bound. Given these two domains of indexical evidence, the thesis sets out to achieve three primary aims.

The first aim is to provide a formal semantic representation of both bound and unbound indexicals which systematically relates them, while distinguishing them from non-indexical expressions. To establish this aim, we informally investigate the relationship between the two types of indexical, and propose a unifying generalisation. This generalisation is then embedded within an existing but novel semantic system, due to Richards, called IQ. IQ is an interval-based semantics for tenses and temporal quantifiers in English which makes use of double-indexing. IQ must be modified so as to properly accommodate indexicals. With a new representation in hand, we demonstrate that the thesis can adequately treat both types of indexical occurrence.

The second aim of the thesis is to assess the effects of the incorporation of the two types of indexical on the semantic entities of IQ. The propositions of IQ already include two major types: value free and value specific. Using the new representation of indexicals, the thesis shows that there are further varieties of the value free proposition. These propositions are then compared with Kaplan's contents, Frege's thoughts and Russell's propositions.

The final aim is to establish a rigorous formulation of a fragment of the version of IQ derived in the thesis. Given this formulation, it is possible to assess its position relative to a landmark in the logic of indexicals. Using mathematical techniques, the thesis proves that the tense operators and indexical operators of the final version of IQ have particular properties which distinguish them from those in other indexical logics also based on double-indexing.

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A Note on Use and Mention

The following conventions are observed, as far as possible, in order to minimise confusion between expressions used, mentioned, or otherwise quoted. Take the following two examples: one is a sentence of English; the other is a sentence of a (fictitious) formal language.

- (a) We must do lunch sometime
- (b) Tomorrow (TELEPHONE (Mary))

Italics will be used for a natural language expression, such as *lunch*, when it is mentioned in the text, and for technical terms introduced during the discussion. Bold, by contrast, will be used for emphasis. When an expression from a formal language, such as the TELEPHONE operator above, is mentioned, it will appear just as it does in the example. If there is any chance of confusing the formal expression with an English expression, as with "Tomorrow", then the formal expression will appear in small double quotes. Large double quotes will be used both for "scare quotes", and verbatim quotes included in running text. Single double quotes will be used in any other context where confusion might occur, as when quoted text includes natural language expressions.

The text-formatting program used to produce this thesis has an occasional problem with footnotes; the reader is therefore warned that a line at the bottom of a page can mean "footnote approaching on a subsequent page".

Chapter 1: Introduction

(I just want to mention - en passant - that all treatments of 'now' and 'then' by philosophers and logicians are hopelessly inadequate for the description of the behaviour of these words in natural language) [Kamp and Rohrer 1983:264]

This is a thesis about the semantics of English temporal indexicals, such as *now* and *then*. Its basic aim is to provide an account of indexicals which is adequate for the description of the behaviour of these expressions in natural language. The introductory chapter helps to establish the aims, methods and organisation of the thesis. It also outlines the aspects of the thesis which represent original contributions to the understanding of temporal indexicals. The discussion here is carried out at a very general level; indeed, the phenomena which motivate the programme pursued in the thesis are not even specified until Chapter 2. They are only mentioned in the introduction in order to make clear the role they play within the general research strategy. So, if the reader is already interested in indexicals, and is familiar with the aims and methods of research in the field, then she can skip to Chapter 2, after reading section 1.2. If, however, further orientation is desired, start here.

1.1 Aims

At the highest level of generality, this thesis should be seen as an essay in cognitive science. It is intended to be a contribution to the study of human mental processing. This does not preclude its being an exercise in the formal and informal semantics of English; it is exactly that. The point is that the research pursued in the thesis fits into a programme the aim of which is to supply a formal semantics for a natural language. And that programme in turn falls within the domain of cognitive science.

For cognitive science, the most appealing variety of semantics is probably the kind which makes explicit appeal to processing considerations. This thesis does not belong to that variety of semantics. It deals with semantic structures alone, largely ignoring the processes which might operate over those structures. Doubtless, it is less directly "cognitive" as a result. But the specification of formal properties of linguistic objects may still contribute to our understanding of mental processing for the following reason. The propositions expressed by linguistic tokens can be taken to correspond to the objects of cognitive attitudes like beliefs. So one way of approaching the psychological properties of cognitive states is via their formal properties.

Anyway, this thesis does not make any claims about cognitive states. Its specific aim is to

try improve the understanding of the behaviour of a certain group of English temporal expressions. We report research into pure temporal indexicals, and treat only with indexical expressions within single sentences. The treatment tendered, however, is designed to be generalisable to multisentence discourses.

What is a pure temporal indexical? In his influential paper “Demonstratives” (1977), David Kaplan divides the class of words he calls indexicals into two groups: pure indexicals and true demonstratives. Among his pure indexicals are *I*, *now*, *here* (in one sense), *actual* and *yesterday*. Pure indexicals are words whose referent is dependent on the context of use, but which do not require a demonstration (or intention or action of any kind) to fix the referent. Among the true demonstratives are words such as *that*, *this*, *she* and *it*. The referent of a true demonstrative is also dependent on the context of use, but it cannot be fixed by the linguistic context alone and requires an accompanying demonstration to pick it out. So, the pure temporal indexicals which are our objects of study include expressions such as *now*, *today*, *tomorrow* and *last year*.

As with all enquiry, a pre-existing theory determines the class of evidence which is regarded as salient, and that evidence in turn drives the search for better theories. The process is, and should be, never-ending, as subsequent theories cover a larger and larger domain of evidence. This thesis, however, represents just a single cycle of the process. The interplay of theory and evidence here gives rise to three specific aims.

The first specific aim is complex, and may be thought of as follows. Initially, the aim is to consider informally two classes of occurrence of temporal indexical expressions. The first of these classes contains the indexicals covered by the existing theory of Kaplan (1977); for reasons which will be explained in Chapter 2, we shall term indexicals in this class *unbound*; the others we shall term *bound*. The intention of this relatively informal discussion is to arrive at an intuitive generalisation which unites bound indexicals with unbound. Next, the aim is to embed that intuitive generalisation within an indexical interval semantics (of which, more below). We may regard this semantics as a new theory, whose adequacy is to be tested against the indexical evidence. Finally, the aim is to alter and adapt the new theory to accommodate both the indexical evidence, and the generalisation which links its two domains. Overall, the first aim is to try to represent and explain indexicals within an adapted new theory.

The second specific aim of the thesis is a thorough examination of the propositions invoked as part of the adapted new theory. To accomplish this aim, it will prove necessary

firstly to survey the effects at a propositional level of the incorporation of indexicals; and secondly, to compare and contrast these propositions with those invoked in established views. It will be shown that the central effect of taking temporal indexicals seriously is related to the notion of a temporally specific proposition; within the chosen semantic framework, there is an important contrast between specific and neutral propositions, which the introduction of indexicals complicates.

The third specific aim is to locate the final theory with respect to a landmark in the field. By the use of mathematical techniques, it will be proved that the final theory is genuinely new, and distinct from that landmark. Taken together with the second specific aim, this will allow the true position of the theory to be assessed.

1.2 What is original about this thesis?

To be original is to be novel, but not vice versa. This thesis contains work which is certainly novel; in order to show that it also contains original work, I'll rehearse the leading ideas of the thesis. These are the ideas which will be elaborated and defended according to the plan outlined in section 1.5 below; this rehearsal should allow us to lay the original and the novel side-by-side.

First, let's consider the empirical data which the thesis attempts to explain. There are two apparently disjoint sets of data. What we call the unbound indexical has been widely discussed, and formal semantic explanations for it have been tendered by, amongst others, Kamp (1971) and Kaplan (1977). The bound indexical, on the other hand, has properties quite unlike its cousin. Initially, indeed, it seemed as though its existence had not previously been noted. It gradually became clear, however, that other researchers, such as Dry (1979) and Kamp and Rohrer (1983), had considered a domain in which there were occurrences of indexicals of a type similar to the bound indexicals considered here. The difference between those earlier studies and the present one lies in their objects of investigation: they touched on examples of indexicals occurring in narrative discourse; this study deals with single sentences in which indexicals act in an unusual way. With this qualification, we may therefore think of the discussion here of the second set of data as an original contribution to the literature.

Secondly, the theoretical framework adopted and adapted to deal with the evidence is novel. It is based on Richards' (1986) presentation of a semantics for a fragment of

English including tenses and temporal quantifiers over intervals. That framework has subsequently been named *IQ*, which can be taken to stand for “Indexical Quantification”. The framework was not designed solely for this thesis, and is therefore not original to it. In order to properly deal with the two types of indexical behaviour, however, the framework had to be modified, and thus its ultimate form is original.

Looking at the *IQ* framework in more detail, we might say that the major innovation of Richards (1986) lay in the combination of two views on tense. The first view, under which tense is not, in a certain sense, an indexical expression, corresponds to a view of propositions which may be conveniently labelled Priorian. The second view, under which tense is indexical, corresponds to a view of propositions which may be labelled Russellian. The *IQ* framework as presented by Richards contains both kinds of tensed proposition; they are the denotations of two different types of tensed sentence in the *IQ* object-language. One type of sentence is derived from the other by the application of a deparametrizing substitution operator. To this version of *IQ*, the thesis adds the insight of Kaplan (1977) that unbound indexicals are both directly referential and context-sensitive. The original twist, then, is that the deparametrizing operator may be turned upon these indexical expressions, to convert them into bound indexicals.

So, with respect to the technical formalism of the thesis, the original contribution lies in two moves. First, the representation of indexicals is altered so as to make them similar in certain respects to tenses. Secondly, the deparametrizing operator is applied to the new representation, and *IQ* is given the power to portray bound indexicals as standing in just the same relationship to unbound indexicals as the tenses which invoke Priorian propositions stand to the tenses which invoke Russellian ones. The first move adapts parts of the *IQ* apparatus to capture Kaplan; the second move adopts a particular piece of apparatus to capture what Kaplan did not consider.

The final aspect of the thesis which might be thought novel or original concerns the propositions which it takes to correspond, more or less, to utterances of English sentences which contain indexical expressions. Against the background of the novel conception of propositions used in *IQ*, issues of temporal and modal specificity are worked out, and the propositions are compared with those invoked by Kaplan, Frege and Russell. *IQ* contains a wider variety of propositions than the other systems: taking propositions to be functions from world-time pairs, it has propositions that go to true at a unique world-time index; it has propositions that go to true at one time, but at many worlds, and it has propositions that go to true at many worlds and times.

This phase of the research might be deemed novel, rather than original; indeed, it even descends from the novel to the exegetical, at certain points. It can be argued, however, that the speculation pursued here, and its products do constitute original moves, essentially for the following reasons. The particular range of propositions arrived at depends both on the tenses of the language of IQ, and crucially, on the innovations made within IQ in order to properly accommodate indexical expressions. Furthermore, we actually prove that IQ's propositions differ from those in Kaplan's (1979) Logic of Demonstratives (LD) in an important respect. While the propositions corresponding to tensed formulas in LD may be true at many world-time indices, those in IQ can be true only at single world-time indices.

1.3 Method

The thesis makes use of a variety of different types of argument and explanation. There are a number of important methodological points to be made. First, we start our investigation of bound indexicals by looking at proverbs, where they seem to occur quite frequently. It would surely be a mistake to build a semantic account of indexicals on the basis that it handles proverbs well; for few would see proverbs as central cases of language use. However, we start off with them for two reasons. Historically, what we call bound indexicals were first noted (by Thomason) to occur in proverbial contexts. And although (as we mentioned above; cf the end of Chapter 2) there are many bound indexicals in multi-sentence discourse, proverbs and their relatives give clear cases of such indexicals in single-sentence discourse. If a theory can explain single sentence cases, then it doesn't have to invoke higher-level principles of discourse organisation to explain the other cases.

Next, it is important to appreciate why we place our theory of indexicals within formal systems such as IQ and LD. We examine possible IQ representations of English indexical sentences, and (ultimately) compare them with possible LD representations. This suggests that we wish to treat the formal systems in a "Montagovian" manner: as actual translations of English sentences. However, IQ currently has no translation algorithm; all we can do now is try to specify target translations for an eventual algorithm. Still, we are constrained by more than one factor. The representation must be truth-conditionally equivalent to the English original. And the syntax of the formal fragment limits us to representations which are well-formed.

These constraints are importantly related to the next methodological point. A central issue is the anomalous status of sentences such as (1) and (2) below. It is assumed that their

oddness is not syntactic; in which case it is either semantic or pragmatic. On a terminological point, we here follow Gazdar (1979:2) and take pragmatics to be concerned with such notions such as implicatures, presuppositions and illocutionary force (Cf also Levinson (1983:1-35)). In this, we depart from Montague (1968), who followed Bar-Hillel's (1954) pioneering work on indexicals, and took formal pragmatics to be focussed on indexical expressions. What Montague called pragmatics, we call semantics.

Now, given this, we may ask whether the kind of anomaly we're concerned with is to be rendered by making the culprit sentences false (à la Russell), truth-valueless (à la Frege) or false in some contextual way (à la Kaplan, Montague et al). In fact, the intuition we use is that if an English indexical sentence is of a kind which, for some reason, can never be true when it is uttered, a formal representation of that sentence ought to reflect this fact in its truth conditions. In particular, to paraphrase Thomason (174:68), such *pragmatic invalidity* originates in the general relation of the proposition expressed by the sentence at the context of speech to features of that context. Hence, although there will be other cases where (say) illocutionary force is at the root of oddity, we largely ignore such cases. Thus we follow Kaplan's (1977) line, and attempt to give a semantic explanation for as many of the phenomena which seem related to indexicals as possible.

The last points to note are that IQ is an interval semantics; and it is an indexical semantics. An interval semantics, the intensions of its temporal expressions are taken to be functions from (amongst, possibly, other things) intervals of time, rather than moments, instants or events. No justification of interval semantics will be offered: it has been advocated by Taylor (1977) and Dowty (1979), and criticised by Tichy (1980a;1985). This thesis has no axe to grind on the subject. IQ adopts intervals partly because one of its principal motivations was the correct treatment of temporal quantification. But the representation of indexicals defended here, although painted within the frame of IQ, does not rely on intervals.

To say that IQ is an indexical semantics is simply to say that it supplies a formal analysis of indexical expressions such as *I*, *here* and *now*; and that it does so by making the extension of an occurrence of an expression depend not only its intension, but also on its context of utterance. In fact, IQ only covers temporal indexicals, and at the moment has nothing to say about either personal or spatial indexicals. Moreover, as has already been indicated, what analysis IQ does offer for temporal indexicals will be replaced by a new one. The reason for IQ's silence on the other indexicals again lies with its origins as an approach to problems relating to temporal quantification. But, given its existing treatment of tenses and temporal quantifiers, IQ is well suited to the formal analysis of indexicals.

1.4 Kaplan and Montagovia

It has been stated that one of the specific aims of the thesis is the development of a theory which can represent and explain the behaviour of two sets of indexical expressions. And the salient characteristics of the theoretical framework to be developed have just been mentioned. IQ lies squarely within the tradition of Montagovian approaches to natural language semantics, whereas Kaplan's approach might be thought distinct from it. We have already mentioned that the new framework IQ differs from Kaplan's framework LD in the domain of evidence it is intended to cover, but there are three other significant differences. At the risk of pre-empting some of the discussion in Chapters 2 and 6, I'll briefly mention those differences.

Dissatisfaction with Montague's (1968;1970) and Scott's (1970) treatment of indexical expressions led to Kamp's (1971) development of double-indexing, and to Kaplan's (1979) formal system. With double-indexing, the intension of an expression determines an extension with respect not just to a circumstance of evaluation, but with respect to a circumstance and the context of utterance. More precisely, a sentence A is evaluated at indices of the form $\langle i, i' \rangle$; i is the time of the context, and stays fixed throughout the evaluation procedure; i' determines the extension of A, and can be altered by the evaluation rules for tense operators and indexicals.

Kaplan (1977:27-33) discusses double-indexing, and finds it wanting, on the grounds that it does not distinguish the two types of meaning which he must invoke to deal with indexicals. Those meanings he calls *character* and *content*; we discuss them at length in Chapter 2. Sag (1981) follows Kaplan, and claims that

[A]ny ... theory which blurs the distinction between character and content ... hence [blurs] the distinction between indexical expressions ... and nonindexical expressions [Sag 1981:291]

It will be shown in this thesis that IQ does not blur the latter distinction, but does blur the former. It has no content/character distinction, but manages very well without it.

Another difference lies in the use IQ makes of the double-indexing framework. It is not the fact of its use that makes the difference, but the manner. In spite of what he says, Kaplan (1977;1979) actually follows Kamp (1971) in the technical realisation of his theory of indexicals. IQ also uses double-indexing, but to rather different effect. We mentioned at the end of section 1.3 that there are propositions in IQ which can be true at only one world-time pair. Occurrences of the tensed formulae of IQ have as their denotations such propositions, because IQ's tenses force them to. LD's tenses, by contrast, have no such effect: its

tenses cannot restrict so severely the range of indices at which its propositions take the value true. Meanwhile, occurrences of the tenseless formulae of IQ which contain unbound temporal indexicals will in general, if true, give propositions which are true at one time index and many world indices; again, LD's indexicals will not be so restrictive.

One further difference between Kaplan's (1977) exposition (though not his (1979) formalisation) and IQ lies in what they take to be the best picture of propositional content. Kaplan advocates Russellian singular propositions, which contain individuals from the domain, over neo-Fregean functions from indices to truth values. IQ accepts the latter.

So: where Kaplan had two types of meaning, we will have only one. Where the propositions corresponding to Kaplan's tensed or indexical formulas can be true at many indices, ours will be true at few. And where singular propositions were a natural concomitant of Kaplan's theory, functions will suffice for IQ.

1.5 Organisation of the thesis

The thesis is organised around its three primary aims: Chapters 2, 3 and 4 deal in turn with the two types of indexical evidence - unbound indexicals and bound indexicals - and the representations IQ gives to each. Chapter 5 treats with the propositions arrived at; Chapter 6 compares and contrasts the resulting IQ framework with Kaplan's LD, and proves there to be a fundamental difference.

In more detail, the plan of action is as follows:

In Chapter 2, we will first introduce unbound indexicals, the phenomenon which Kaplan's theory of indexicals was intended to explain. Then, the resources used in his explanation will be compared with an obvious, if theory-laden explanation. This will allow us to see the primary motivations underlying Kaplan's approach, as well as certain difficulties lurking beneath it. Next, the second phenomenon, bound indexicals, will be introduced. The difference between indexicals bound and unbound will be noted. Then, an informal survey of similar phenomena will be carried out, so that the particular features of bound indexicals may be assessed. With this in mind, it will prove possible to propose a generalisation which unites the two domains of evidence.

In Chapter 3, we will first outline the essential features of IQ, the semantic formalism

which promises to capture both the evidence, and the generalisation from Chapter 2. We will then criticise the existing IQ treatment of indexicals, and isolate its weakness. An essential point will be that it gives no semantic account for the unacceptability of sentences such as (1) or (2):

- (1) ?It will rain last year
- (2) ?John ate his breakfast tomorrow

Then, the deparametrizing operator will be introduced by way of examples involving tenses and temporal quantifiers. We take tenses to include the past, present and future logical tenses, and temporal quantifiers to include frequency adverbs such as *always*, *never*, *exactly twice* and *sometimes*. It is perhaps worth noting that the logical tenses do not, of course, correspond one-to-one with the tenses of English, which possesses only two tenses: past and present. To effectively apply the deparametrizing operator to indexicals, we will have to provide a new representation for indexicals, which assimilates them in some respects to tenses. This new representation is then tried out on a number of examples. These include, amongst others, a sentence like (1) which we wish to semantically exclude, and another which involves an unusual use of an indexical. Having established the representation's adequacy, certain consequences of adding it to the language of IQ are investigated. In particular, a new representation for perfective aspect is proposed and defended. By this stage, it should be clear that the new IQ representation of indexicals manages to capture Kaplan's evidence in such a way as to allow other significant generalisations to be expressed.

In Chapter 4, it will be shown that the use of the new representation, together with the deparametrizing operator, is sufficient to capture the bound indexicals introduced in Chapter 2. We consider in turn what representation must be assigned to two cases from the second domain. To provide the requisite representations, it'll turn out to be necessary to improve IQ's treatment of indirect speech reports; to alter its representation of imperatives; and to supply an analysis of conditionals. With these changes in hand, a demonstration that IQ can handle each of the cases can be given. Thus, the strategy of embedding the generalisation from Chapter 2 within the framework of Chapter 3 will have been shown to be empirically adequate.

In Chapter 5, the nature of the propositions which are the denotata of IQ sentences will be investigated. This discussion will be carried out in two distinct phases. First, the dictates of the internal structure of IQ will be examined. Concentrating on the effects of indexicals on the temporal specificity of propositions, the research builds on the treatment of indirect speech reports in Chapter 4, and incorporates the insights of Chapter 3. In the second part of the chapter, the propositions derived in the first are compared in turn with the semantic

entities which are supported by three alternative views on semantics. The propositions are compared with Kaplan's contents, Frege's thoughts and Russell's propositions. Again, temporal specificity is taken to be a significant dimension of comparison. In the discussion of Frege, a certain amount of attention will be devoted to the sense/reference distinction and the hierarchy of senses, in order to demonstrate that IQ does not share certain characteristics with neo-Fregean theories. By contrast, in the discussion of Russell, we will focus on the role of tense in unifying IQ propositions, in order to show that IQ does share certain characteristics with Russellian semantics.

In Chapter 6, we will provide rigorous formulations of fragments of IQ and Kaplan's LD, for the purposes of comparison. Such a comparison will allow us to specify IQ's position as a formal system with respect to the existing, well-known Logic of Demonstratives. By considering how to translate formulae of the LD fragment into the IQ fragment, we will be able to show that IQ can represent all the distinctions between validity and necessity which Kaplan was concerned to make. Furthermore, a proof will be given that a fragment faithful to Kaplan cannot capture the restrictive properties of the operators in the IQ fragment, which we mentioned in section 1.4. Consequently, IQ is not a mere notational variant of LD, but represents a proper extension of it. A possible addition to the Kaplan fragment will then be suggested; this will allow it to simulate the properties in question. Finally, some outstanding issues concerning the relationships between the formal fragments and natural language will be canvassed.

In Chapter 7, the developments of the thesis will be summarised, and its success evaluated. Outstanding problems will be mentioned, and suggestions for further research will be sketched.

Chapter 2: The Phenomena

In this chapter, two aspects of the behaviour of pure indexicals will be studied in some detail. The first type of behaviour has been dealt with in considerable detail in Kaplan (1977). The second type of behaviour has received rather less attention. For reasons which will become apparent, we shall refer to occurrences of the first kind as *unbound* indexicals, and occurrences of the second kind as *bound* indexicals.

The chapter falls into two parts. In the first, unbound indexicals will be introduced, and possible explanations of their behaviour will be canvassed. David Kaplan's decision to explain the behaviour as a manifestation of the directly referential nature of indexicals will be examined in some detail, in order to determine what distinguishes this proposal from simpler ones. To explain the notion of direct reference, it is necessary to examine the roles which contexts of use and counterfactual circumstances play in Kaplan's theory, and to discuss the introduction of an additional level of meaning - character - into the theoretical framework. There are certain difficulties inherent in using functions to represent direct reference. By examining these, we can determine precisely what work direct reference does in Kaplan's explanation unbound indexicals.

In the second part of the chapter, we shall introduce bound indexicals. Starting from a particular example, a taxonomy of instances of the unusual behaviour will be built up. The discussion of bound indexicals will be less technical, but it should be possible to establish what distinguishes them from unbound indexicals in a way which illuminates the mechanisms underlying indexicals in natural language.

It should be noted that this chapter will include discussion of personal and locational indexicals as well as temporal ones; this is simply to allow a better grip on the evidence through the consideration of a broader range of examples.

2.1 The First Phenomenon: Indexicals Unbound

The phenomenon in question can be outlined with a couple of examples:

- (1) It will soon be the case that all that is now beautiful is faded.
- (2) It is possible that in Pakistan, in five years, only those who are actually here now are envied.

The question arises as to what time the word *now* in these examples (each uttered, let us say, at t_0) refers to. The obvious answer is that *now* refers to the time of utterance t_0 . What is remarkable about this answer is that it means that *now* is an expression whose reference is unaffected by linguistic contexts which normally have rather serious effects on expressions within their scopes. In this respect, it differs from definite descriptions and many other expressions. To be more specific, *now*, like the other indexicals in these examples, cannot have its reference altered by the natural language expressions which correspond to intensional operators. In the case of *now*, neither tenses nor contexts such as *It will soon be the case that* can shift its reference: *now* is evaluated relative to the time of speech and no other. Thus, in (1), *now* ensures that the beautiful things we are talking about are those which are beautiful at the time of speech. If it did not, (1) would be trivially false, for an utterance would have to be interpreted as saying that things were both beautiful and faded at the same time, which is not generally held to be possible.

The phenomenon is a complex one, involving the interaction of tenses, quantifiers and indexicals; but its existence is undeniable, and it places a major constraint on a semantic theory which attempts to explain temporal indexicals. The theory must be able systematically to distinguish unbound indexicals from non-indexical expressions, in a way which captures the data. That is: if we're in the business of providing a formal representation of temporal indexicals which lays bare their semantic role in natural language, then the representation must cover all and only those indexicals. One way of describing the phenomenon is in terms of the representation about to be proposed: the semantic values of indexicals will always leap outside the scope of intensional operators; to this extent, indexicals remain *unbound*. Unbound indexicals are the standard logician's indexicals: the time towards which, say, *today* directs us is determined by extralinguistic context alone.

2.2 Proposals for Formalisation

How might we go about giving a formal representation for indexicals? Once it is agreed that t_0 is the time we are interested in, there is an immediate, if theory-laden, explanation of this fact. The explanation arises from the following line of thought. Indexicals cannot simply be represented as definite descriptions, because definite descriptions may take either narrow or wide scope with respect to an intensional operator. Unbound indexicals only take wide scope with respect to intensional operators, so they cannot be ordinary definite

descriptions'. But suppose we claim that indexicals are wide scope definite descriptions. What would follow from such a claim? When an expression in a sentence takes wide scope, it must always be evaluated before applying modal, temporal or locational operators to the rest of the sentence. To illustrate the point, and to show what role scope distinctions can play in solving theoretical problems, a small excursion into a famous opaque context is helpful.

Smullyan's (1948) response to Quine's celebrated (1943) statement of the problem of referential opacity was to treat the apparent failure of substitutivity in terms of the scope of definite descriptions. N is read as the operator *necessarily*.

- (3) 9 = the number of the planets
- (4) N (9 > 7)
- (5) N (the number of the planets > 7)

The problem is that (3) and (4) are true, while (5), which should follow by substitution of coreferring expressions, is false. Smullyan points out that if *the number of the planets* is treated as a definite description, then on rendering (3)-(5) into an appropriate first order form, an ambiguity in the reading of (5) can be uncovered.

- (6) $y = (\lambda x)(\phi x)$
- (7) N ($y > 7$)
- (8) $[(\lambda x)(\phi x)]$ N $[(\lambda x)(\phi x) > 7]$
- (9) N $[(\lambda x)(\phi x)]$ $[(\lambda x)(\phi x) > 7]$

(5) can be read either as (8) or (9), depending on whether the definite description $(\lambda x)(\phi x)$ is treated as having primary (that is, widest) or secondary scope. In English, (8) and (9) can be rendered respectively as

- (10) The number of the planets is such that it is necessarily greater than 7
- (11) Necessarily, the number of the planets is greater than 7

Smullyan argues that Quine takes (5) to be like (9), where the definite description has secondary scope, and false. Smullyan accepts the falsehood of (9), but asserts that it does not follow from (3) and (4). By contrast, if (5) is read as (8), in which the definite description has primary scope, then it is both true and a valid inference from (3) and (4). Thus the failure of substitutivity is only apparent. It has been pointed out, however, that Smullyan's solution rests upon two assumptions which Quine wouldn't accept. First, it requires a distinction between names and definite descriptions which Quine doesn't admit in his formal system. Secondly, the definite description, when unpacked, can be represented as (12).

¹ The existence of a large set of exceptions to this rule is a new discovery: it was certainly not considered seriously by Kaplan. The exceptions are dealt with in section 2.6 et seq.

$$(12) \quad (\exists c)(x)[(\phi x = x=c) \ \& \ N(c > 7)]$$

It becomes clear that the solution calls for quantification over an intensional operator, which is precisely the point which Quine will not concede. It is obvious from this that giving a particular class of expressions wider scope than sentential operators in an intensional language necessarily involves quantifying-in. Following Kaplan (1969), we have no objection to quantifying-in. We could, with Kaplan (1977), allow (13) as an English paraphrase of (2) which reveals the relative scope of its constituent expressions, and give (14) as a formal representation of it.

- (2) It is possible that in Pakistan, in five years, only those who are actually here now are envied.
- (13) The actual circumstances, here, and now are such that it is possible that in Pakistan in five years only those who, in the first, are located at the second, during the third, are envied.
- (14) $(\exists w)(\exists p)(\exists t) [w=\text{the actual circumstance} \ \& \ p=\text{here} \ \& \ t=\text{now} \ \& \ \leftrightarrow \text{In Pakistan In five years } (x)(x \text{ is envied} \rightarrow x \text{ is located at } p \text{ during } t \text{ in } w)]$

However, it should be clear that if we claim that indexicals are wide scope definite descriptions, we face two major problems. First, there is a sense in which we have provided a label rather than an explanation. Something which is a definite description which can only take wide scope can't really be a definite description, since having variable scope is part and parcel of being a definite description. Secondly, the proposal fails to distinguish indexicals from non-indexical definite descriptions which happen to be in wide scope position. Thus the proposal doesn't come close to satisfying the constraint we suggested in section 2.1.

2.3 Kaplan's Proposal

Kaplan does not wish to represent indexicals merely as terms which always take primary scope. He has an alternative theory which leads him to be ambivalent, if not actually hostile, towards the obvious proposal. In order to properly appreciate the advantages of Kaplan's view over the approach just outlined, it is necessary to examine Kaplan's theory of indexicals in some detail. The basic point, however, can be simply put: Kaplan maintains that indexicals are directly referential terms; he sometimes contrasts this with the view that they are primary-scoping terms, and at other times takes the two to be nearly equivalent. Such ambivalence suggests that Kaplan thinks that while it is possible to represent indexicals in the way suggested above, such an approach merely approximates the truth, and as such should be discarded in favour of the direct reference approach he advocates.

In other words, Kaplan would agree that the obvious proposal fails adequately to distinguish indexicals from non-indexicals. To judge the success of Kaplan's alternative, a statement of what constitutes a direct reference theory is required, together with an outline of Kaplan's theory of indexicals. When the consequences of introducing the notion of direct reference have been examined, we can compare Kaplan's proposal with the suggestion that indexicals might be thought of as rigid designators, in Kripke's (1972) sense of the term.

2.3.1 Direct Reference Theory

First, then, it should be observed that Kaplan describes a direct reference theory as being a theory of meaning in which certain singular terms refer directly without the mediation of a Fregean Sinn ². The proposition expressed by a sentence containing such a term would involve individuals directly rather than via individual concepts or modes of presentation. He dubs such terms *directly referential* and the propositions containing them *singular propositions*. He also states:

I intend to use 'directly referential' for an expression whose referent, once determined, is taken as fixed for all possible circumstances, ie is taken as the propositional component. [Kaplan 1977:12]

Talking metaphorically, and in terms of possible worlds, a directly referential term is one which allows us to plug an entity from the domain straight into a proposition without, as it were, checking each possible world to make sure that that entity is the referent of the term in that world. For Kaplan, it is the fact that indexicals contribute no descriptive content to the proposition that corresponds to their lack of ambiguity under intensional operators.

2.3.2 Kaplan's Theory of Indexicals

Kaplan's theory is based on two obvious principles ³. The first is an observation, the second is a theoretical claim:

- | | | |
|-----------|----|---|
| Principle | 1: | The referent of a pure indexical depends on the context, and the referent of a demonstrative depends on the associated demonstration. |
| Principle | 2: | Indexicals, pure indexicals and demonstratives alike, are directly referential. |

Kaplan holds that the first principle is both obvious and widely-held while the second is

² Where Sinn is understood as a Carnapian intension. As Evans (1982:62) points out, taking Sinn to be a proprietary way of thinking may generate an ambiguity when taken with some of Kaplan's other statements on the nature of direct reference. We discuss Sinn at greater length in Chapter 5.3.3.

just as obvious, but not generally recognised. Indexicals are both context-dependent and directly referential. By Principle 1, in treating sentences like (2), we should take the values of *now*, *here* and *actually* from the context of the utterance. By Principle 2, it is these values that enter directly into the proposition, so that temporal, locational and modal operators cannot influence them. And it is for this reason that unbound indexicals leap out of the scope of the operators that attempt to bind them.

2.3.3 Character, Content, Context and Circumstance

Kaplan's "obvious" theory has just been given. It remains to be seen, however, just how obvious the notion of a directly referential term actually is, both formally and informally. In order to clarify the notion, and draw out its consequences, the apparatus for dealing with instruments of direct reference will be briefly outlined.

Kaplan distinguishes two kinds of meaning: *character* and *content*. These are explained in terms of *contexts of use* and *circumstances of evaluation*. For Kaplan, both contexts and circumstances may contain many features such as speakers, objects demonstrated and possible world histories. Since we will be discussing only pure temporal indexicals, it is convenient to think of circumstances as pairs of possible worlds and times; or even just as possible worlds. We follow the former course in Chapter 6.

A character is a meaning of a sentence type. Sentences generally contain context-sensitive expressions, such as indexicals and tenses. Derivatively, we may speak of the character of such expressions. A content (or proposition) is the meaning of a sentence token - an occurrence of a sentence in a context. Again, we may speak of the content of subsentential expressions.

A content is determined by a sentence type together with a context of utterance; the context determines the referents of the indexicals contained in the sentence. The content of a sentence, in turn, is a function from circumstances (possible worlds) to truth values. Derivatively, the content of an expression in a context is a function from possible worlds to extensions.

So, if we are prepared to think of character and content in terms of functions taking arguments and values, we have the following picture ⁴:

³ First stated Kaplan (1977:10)

Character of sentence:	Context	—>	Content
Content of sentence in context:	Circumstance	—>	Extension

Or, in more familiar terms,

Meaning + Context	—>	Intension
Intension + Possible World	—>	Extension

Finally, two sentences may agree in content, but differ in character; and two sentences may agree in character, but differ in content, given different contexts. To see that this is so consider (15) and (16):

- (15) It will rain tomorrow
(16) It will rain today

Utterances of (15) and (16) on subsequent days agree both in truth value and in *what is said* - the content of the utterances. Two distinct utterances of (16) on different days say different things, because *today* picks out different days.

Indexicals are context-sensitive; so their character gives different contents for different contexts. For instance, *now* will typically pick out a different time from utterance to utterance. But indexicals are directly referential too. Thus, a given occurrence of an indexical will have the same content in every possible world (circumstance); that is, it will have the same referent in every world. In the case of *now*, that referent will be whatever time *now* picked out in the actual context of utterance, not what time would be picked out by an utterance of *now* in some other possible world. Kaplan (1977:44) gives the following rules as the character of *I*:

- (17) D1 *I* is an indexical, different utterances of which may have different contents.
D2 In each of its utterances, *I* refers to the person who utters it.
D3 *I* is, in each of its utterances, directly referential.

By contrast, a non-indexical definite description, which is not directly referential will not be context-sensitive. Thus its character is fixed, in that it gives the same content in every context. On the other hand, the definite description will typically be “possible world sensitive”, and its content will be unfixed, giving different extensions in different possible worlds.

According to Kaplan, the terminology that has been introduced reveals that “direct reference” is a slightly misleading name for the way indexicals work. It should not be assumed that reference is not mediated by meaning at all: the character of an indexical, after all,

⁴ Kaplan has reservations about this function-picture, to which we return when we discuss the difference between direct reference and rigid designation.

determines the referent, which in turn determines the content. The point of the name is rather that content (or sense) does not determine the referent, but vice versa. In other words, there is a road back. So for Kaplan, reference is direct, in that it is accomplished without going through content first, but it cannot be accomplished without going through some meaning, namely character. Indexicals have descriptive meaning (character), but having determined what the content of an occurrence is to be, that meaning plays no part in the content itself.

2.4 Representing Direct Reference

The picture above, where character maps contexts into contents, and content maps possible worlds into extensions, is an appealing one. But Kaplan doesn't like it, for two main reasons. It conflates the representations of all necessary truths, and it conflates direct reference with rigid designation. We'll consider each of these points in turn.

Kaplan's fundamental point is a good one: there is a problem presented by distinct but equivalent contents receiving the same function from possible worlds to extensions as their representation. In the case of sentences, certain distinct propositions will be assigned the same function. Presumably, all propositions expressing necessary truths will be covered by the same function. Obviously, necessary truths are not just a problem for someone trying to give a possible worlds representation for Kaplan's two levels of meaning; they are a problem for anyone engaged on the enterprise of using possible worlds semantics for intentions. Be that as it may, they are problem enough to warn us of the inadequacy of the functional representation of content.

Incidentally, the problem recurs at the level of character. Expressions with distinct but equivalent characters are those with different rules relating the expression to its content in context, but which pick out the same content in every context. If it is allowed that two sets of character rules are minimally different if they mention a different lexical item, but are otherwise identical, then it might be argued that *person* and *human* have differing characters, while each picks out just the same content in every context. To represent the character of these words with the same constant function from contexts to contents would be to conflate them.

So Kaplan is perhaps right to be sceptical about the function picture. There is a further reason for worry, which he does not consider. According to the technical definition of context,

reason for worry, which he does not consider. According to the technical definition of context, if two interlocutors used the word *I* simultaneously, they could not have spoken in the same context (since *I* must have a unique referent in a context). And yet, if we take the not unreasonable view that there could be two speakers in the same context, then contexts cannot be used as the input to functions, since *I* could have more than one content in the same context. Even if one accepts Kaplan's technical definition of context, one must distinguish it from his use of contexts in Principle 1 of his theory of indexicals, and in his character rules for *I*. In so doing, we must sacrifice the above intuition on the altar of formalisation. Kaplan (1977:47) accepts this price.

We turn now to Kaplan's second major objection to the picture in which content is represented in terms of functions from circumstance to context. If the project is carried through, there would be no perceptible difference between rigid designators and directly referential terms. Kaplan's argument goes as follows. He observes that it is necessary to take care in comparing direct reference with rigid designation, since there is more than one notion at work in Kripke's (1972) definition of a rigid designator. On the one hand, a rigid designator is defined as a term with the same designation in all possible worlds (Kripke (1972:269)); on the other, it is allowed that a rigid designator need not designate the object (or any other object) at worlds in which the object does not exist (Kripke (1972:270))⁵. Suffice it that what follows applies to the former notion (or to strongly rigid designators).

Kaplan's point is that a rigid designator which picks out the same object in all possible worlds will be assigned a constant function as the representation of its content (or intension). As we have seen, a directly referential term will also receive a constant function as its representation. It is Kaplan's contention, however, that the two classes of terms are given the same type of representation for rather different reasons. The content of a rigid designator such as *Moses* may justifiably be represented by a constant function, because it is indeed the case that the referent of the name is the same individual in every possible world. By contrast, the content of an occurrence of a directly referential term such as *today* is not merely a function, but is the day of speech itself. The closest the function-picture can come to this is the constant function from circumstance to extension, and for Kaplan's purposes it is not close enough to portray a vital aspect of direct reference: the referent in the circumstances is simply independent of the circumstance.

⁵ Kripke's introduction of the notion of a *strongly* rigid designator, whose designation exists in all possible worlds, suggests that the second of the two notions above is the one Kripke intended. Kaplan, however, maintains that Kripke is committed to the former notion - the stronger one - as the standard definition of a rigid designator. See Kaplan (1977) Section IV and Note 6 for a discussion of this question.

object in every circumstance, while rigid designators may be constructed such that their rigidity is, so to speak, accidental.

(18) The n [(Snow is slight & $n^2=9$) \vee (-Snow is slight & $2^2=n+1$)]

There are rigid designators which have descriptive, or conceptual, content at the level of content, whereas no directly referring terms have descriptive content at that level. All directly referring terms are rigid designators, but there are some rigid designators, such as (18), which are not directly referring terms. Kaplan claims that the crucial difference between directly referential terms and rigid designators lies not in the mere fact that a directly referential term designates the same object in every circumstance (since rigid designators do so too); it is in the way the directly referential term designates an object in every circumstance. Like every other expression, an indexical has rules which determine the object in each context of use; however,

The rules do not provide a complex which together with a circumstance of evaluation yields an object. They just provide an object. [Kaplan 1977:14]

The truth of Kaplan's claim is that the descriptive meaning of a directly referential term is no part of the propositional component. This is another way of saying that character is prior to propositional content, and plays no part in the propositional picture of the meaning of an utterance.

It is perhaps instructive at this point to note the directly referential nature of free variables:

Now free variables under an assignment of values are paradigms of what I have been calling directly referential terms. In determining a semantical value for a formula containing a free variable we may be given a *value* for the variable -- that is, an individual drawn from the universe over which the variable is taken to range -- but nothing more. A variable's first and only meaning is its value. [Kaplan 1977:5]

In other words, the referent of a directly referential term like a variable is not picked out in specifying the model, but in the value assignment. The referent is handed to us by the semantic rules themselves. It is clear that indexicals are like variables in that their referents depend not on the model, but on the value assignment. On the other hand, indexicals differ from variables in that their potential referents are drawn not from the whole universe of discourse, but from sets of entities which are determined by extralinguistic context. Furthermore, ordinary variables are generally unsorted, while indexicals are generally sorted: *I* is sorted for persons, *here* for places, *now* for times.

The foregoing account of Kaplan's theory of indexicals is necessarily incomplete, but it allows us to see the apparatus which he believes is required to capture the context-

See Kaplan (1977) Section IV and Note 6 for a discussion of this question.

dependent yet directly referential nature of indexical expressions. Kaplan has to construct a two-level theory of meaning in order to represent the context-dependent behaviour of indexicals.

Furthermore, the mathematical device of using functions to represent indexicals is clearly inadequate because it is incompatible with Kaplan's decision to treat the content of an indexical as an individual from the domain. Kaplan suggests representing content via structured propositions, of the type espoused by Russell (1903), while maintaining that a semantic theory should presuppose neither framework. Kaplan's preference seems to be for the latter.

Kaplan proposes that we should regard indexicals as (context-sensitive) directly referential terms. Such a position is to be contrasted both from the naive proposal - where indexicals are wide scope definite descriptions - and the rigid designator proposal. It differs from them both in that Kaplan's indexicals are taken to contribute no descriptive meaning to the contents (or propositions) expressed by the sentences which contain them. Both the definite description proposal and the rigid designator proposal leave open the possibility that the descriptive meaning of indexicals enters into the propositions expressed. In the next section, we consider in more detail the gains Kaplan makes.

2.5 The Proposals Compared

We've already indicated why the naive approach to unbound indexicals, outlined in section 2.2 is inadequate. Here, we will summarise the advantages of the Kaplan proposal over the earlier proposal. Recall that we expect a theory of indexicals to cover the evidence, and distinguish indexicals from non-indexicals. Given Kaplan's position and the primary scope proposal, there are essentially three points at which superiority might be claimed for Kaplan's theory. The first point concerns empirical coverage; the others involve the distinction between indexicals and non-indexicals. Indexicals should be distinguished from non-indexicals both on the grounds of context-sensitivity and on the grounds of direct reference (non-descriptive rigidity). Let us consider each of the three points in turn.

In considering the limitations of the scope proposal at the end of section 2.2, we observed that a definite description which only takes wide scope cannot really be regarded as a description. Either indexicals only take wide scope and are not descriptions, or they are descriptions and don't just take wide scope. If we try to take indexicals to be disguised

descriptions, it seems as though we reveal the scope proposal to be empirically mistaken. This is because it predicts an ambiguity in natural language where there is none. The argument might go as follows: Smullyan's solution to Quine's problem revolves around the detection of an ambiguity between wide and narrow scope readings of a description. But if indexicals are explained in terms of scope, then we would predict both wide and narrow readings of indexicals. The whole point of isolating unbound indexicals as a phenomenon is that we must account for the fact that there are only wide readings of indexicals in natural language.

Given Kaplan's demarcation of the indexical evidence, this would be valid criticism. As we shall see in sections 2.6 onwards, however, it will turn out that the primary scope solution may actually have a better coverage of the evidence than Kaplan's theory of indexicals. So much the worse for Kaplan; but not so much the better for the scope proposal. For if it transpires that there are narrow readings for indexicals, then we must abandon the claim that indexicals are definite descriptions which somehow always have wide scope. They would be just like ordinary descriptions. Thus there would be two things that needed explaining: first, how is it that the unbound indexicals we isolated are wide? Secondly, what is the difference between indexicals and non-indexicals? Before, the proposal failed to distinguish indexicals from non-indexical definite descriptions which happened to be in wide scope position. Under these circumstances, it would be even worse: the proposal couldn't even distinguish indexicals from non-indexicals at all.

So, the scope proposal fails on grounds of poor coverage, if only unbound indexicals are to be considered, and on grounds of explanatory inadequacy if we generalise the discussion to include the bound indexicals introduced below. It might be thought that there is in fact a distinction between indexicals and non-indexicals under this approach. It's to this second point that we now turn.

Kaplan (1977:19) observes that neither indexicals nor quantification across intensional operators (the scope proposal) can be traded in for the other. He also points out that if naive treatment of indexicals is like the one we sketched in section 2.2, we are always left with unreduced indexicals in the formal representation of the original indexical utterance, as in (14) and (2):

- (2) It is possible that in Pakistan, in five years, only those who are actually here now are envied.
- (14) $(\exists w)(\exists p)(\exists t) [w = \text{the actual circumstance} \ \& \ p = \text{here} \ \& \ t = \text{now} \ \& \ \Diamond \text{ In Pakistan In five years } (x)(x \text{ is envied} \rightarrow x \text{ is located at } p \text{ during } t \text{ in } w)]$

So, there is apparently a difference between indexicals and non-indexicals, whatever their scopes: the representation of the indexicals contains reference to aspects of the context of use. But that in itself is not a great advantage: the proposal has merely deferred the question of the reference of the indexicals, without specifying the special limitations on their reference. Basically, it's unable to capture the context-dependence of indexical reference. With unreduced indexicals in the representation, reference is left unfixed. So the second problem with the straightforward scope proposal is that it fails to capture Principle 1 of Kaplan's theory of indexicals.

The third criticism that we may level at the proposal that indexicals are definite description of some sort or other has already been mentioned. The crucial problem is the absence of any serious distinction between the directly referring indexicals and other expressions at the level of logical form. To put it another way, the scope proposal fails to distinguish terms without descriptive content from those with descriptive content; indeed, it positively assimilates them.

This is the essential difference between the naive proposal and Kaplan's. He allows that it is possible to approach the question in terms of scope, but must be committed to the view that scope cannot constitute the whole explanation, on the grounds that the peculiar behaviour of indexicals demands a formal distinction between indexicals and non-indexicals, either in the logical form itself or in their differing semantic roles. With the primary scope proposal on its own, that distinction has not been forthcoming. That proposal leaves the context-sensitivity of indexicals undischarged, and it doesn't distinguish the directly referring indexicals from expressions with descriptive content, such as definite descriptions and rigid designators with complex forms.

Direct Reference Theory allows the distinction to be made, by turning indexical expressions into logical expressions, whose denotations do not vary with the particular interpretation of the model, but are fixed at the same level of the semantics as the assignment of values to variables. The fact that this is the practical consequence of Kaplan's theory can be confirmed by examining his Logic of Demonstratives, where indexicals are independent of the model, though not, of course, the context of their use ⁶. On Kaplan's theory of indexicals, what does the fixing at the pre-propositional level is the context of utterance. Thus Kaplan's proposal represents an advance over the naive primary scope proposal on two counts, both related to explanatory adequacy. Kaplan manages to capture the context-sensitivity of indexicals; and he explains (via direct reference) why the reference of *now*,

once it has been fixed by context, cannot be manipulated by any intensional operator.

However, in considering the first potential criticism of the obvious treatment of unbound indexicals, we mentioned that Kaplan's empirical coverage may not be as perfect as we have so far assumed. For this reason alone, we cannot conclude that Kaplan's theory is an unqualified success.

Kaplan has demonstrated that the unbound indexical must be taken seriously, but he has not shown that it can only be treated within a two-level theory of meaning. A two-level theory whose top level corresponds to surface structure with a little synonymy thrown in seems a trifle extravagant; therefore, we shall in Chapter 3 investigate the possibility of using a mono-level theory which still captures the dual nature of indexicals, which are both context-sensitive and directly referential.

In terms of Montague's PTQ (cf Dowty et al (1981)), the reference of an indexical will be fixed at the same time as the value assignment function g , instead of by the interpretation function F . So, indexicals will differ from proper names, whose reference is determined by F ; and from variables, whose value is assigned by the function g , for indexicals will have their referents fixed by a different, contextually defined function.

The theory of temporal reference espoused in Richards (1986) represents a mono-level theory which may be able to represent indexicals, while appropriately distinguishing indexicals from non-indexicals. However, an examination of the role of indexicals in Richards is not the next step itself⁷. For while it is true that Kaplan dealt with a wide variety of indexicals, he treated them as if they were always unbound, and always leapt beyond the scope of intensional operators. This is not the case. As we indicated above, we shall soon see that there are many exceptions to Kaplan's rule: the bound indexical is not such a rare bird as it might at first appear. What's more, the few ways of binding indexicals that exist lay bare the mechanisms that underlie their normally unbound state.

⁶ See for instance Kaplan (1979) or Kaplan (1977) Section XVIII; LD*, the version of LD expounded in Chapter 6 of the thesis, is the same in the relevant respects.

⁷ That task is undertaken in Chapter 3, sections 2 and 3.

2.6 The Second Phenomenon: Indexicals Bound

In the first part of this chapter, the tendency of indexical expressions such as *now* and *yesterday* to leap out of the scope of intensional operators was studied in some detail. Under the terms of the scope proposal, it turned out that in order to represent indexicals in straightforward first-order terms, it was necessary to quantify in over intensional operators such as *it is possible that* and *in five years*; the referent of the indexical was not fixed or even influenced by the intensional operator, and the term representing the indexical could be bound only by a quantifier standing before the operator in the first-order sentence. In the rather different terms of Kaplan's alternative proposal, such indexicals are directly referential terms.

In the next few sections, a set of rather peculiar exceptions to the unbound behaviour of indexicals will be examined, and a possible unified formal representation of both standard, unbound indexicals and the exotic exceptions will be proposed. In certain contexts, indexicals such as *now* and *I* will not leap out of the scope of an intensional operator, and will actually allow themselves to be bound by a quantifier within the scope of an intensional operator. For this reason, these cases will be referred to as instances of *bound* indexicals.

First, the existence of bound indexicals in proverbs will be demonstrated, and it will be suggested that proverbs are similar in certain respects to sentences containing quotation marks and to sentences in the imperative mood. Each of these options will be examined in turn in order to determine to what extent the analogies hold. In the case of quotation, it will be argued that while quotation marks operate on the character of sentences in a suggestive way, their effect on the reference of indexical expressions is not quite what we are looking for. In the case of imperatives, it will be shown that by distinguishing amongst types of commands, it is possible to locate cases of bound indexicals which closely resemble proverbs. On the basis of these examples and counterexamples a formal distinction between bound and unbound indexicals will then be suggested.

2.7 Proverbs

One context in which the rule of primary-scoping fails is in proverbs such as the one cited by Kaplan (1977, n13.2), due to Thomason.

- (19) Never put off until tomorrow what you can do today

If *today* and *tomorrow* were to act like primary scoping indexicals, their respective referents, on an occasion of utterance, would be the day of the utterance and the day after. But the proverb doesn't simply mean that things to be done on t_0 should be done then rather than on t_1 : its claim is more general. Perhaps, then, the temporal quantifier *never* is binding the indexicals, and preventing them from having their standard referents. There is a certain plausibility in the notion that a temporal quantifier might bind singular temporal terms; but if the usually unbound indexical is to be taken seriously, there must be some model-theoretic apparatus to enable the quantifier to stop *tomorrow* being assigned its reference directly, before the value assignment. The same mechanism would have to be invoked to explain (20), from Thomason (ed) (1974:65). But even if this mechanism were to be supplied, it would not immediately explain why the indexicals fail in (21), a close variant of (19), which apparently contains no temporal quantifier:

- (20) Tomorrow never comes
(21) Don't put off until tomorrow what you can do today

Two points about (21) should be observed: first, it has a feel a little like a quotation; secondly, in those cases where this intuition is weaker, the feel is closer to that of an imperative. Each of these points will be examined in turn. In what follows, we aren't claiming that proverbs (or commandments) form a homogeneous class. Some are indeed "fossils", without significant semantic structure. But we will be focussing on those others which do have a role to play in language; and whose role is reflected in the semantics of their temporal indexicals.

2.8 Quotation

Metaphorically, and contrary to Kaplan's theory, the proverb defeats direct reference. What seems to be happening is a shift in the reference of the indexical. To follow Kaplan's theory for a moment, the behaviour of the bound indexicals is particularly disconcerting, since it appears as though both principles of his theory are being flouted: the indexical *tomorrow* in both (19) and (21) is neither context-sensitive nor directly referential. On Kaplan's two-level theory of meaning, altering the reference of an indexical involves operating on the character of that expression, by analogy to the alteration of the content of a sentence by the application of an intensional - or content - operator. Kaplan considers whether there could be such creatures as character operators in his language, but ultimately rejects them. In fact, he is willing to concede that quotation marks act as character

operators, but he claims that they are metalinguistic devices, turning use into mention. Thus he leaves them out of his language LD, and does not consider them further.

There have been logical attempts to account for the semantic effects of quotation marks. Quine's position was that the marks formed expressions whose contained words had no separate status. Frege urged that words in quotes did denote; what they denoted were words, rather than things. In what follows, and particularly in considering the relation between proverbs and quotation, we are not subscribing to a particular logical theory of quotation. If anything, the view is naive: it is simply driven by straightforward observations on the role of indexicals in quotation marks, and the role of indexicals in proverbs.

Given this, there are two facts which, taken together, should make one feel at least a little uneasy with Kaplan's decision. First, English is a natural language without divisions between object-language, metalanguage and meta-metalanguage. Secondly, English as a natural language contains proverbs, quotations and reported speech. If a semantics for the whole of a natural language is the ultimate aim of the research, then at some point or other, a formal treatment of such constructions must be given. Since any particular piece of research will only attempt to give a semantics for a fragment of a natural language, it is perfectly legitimate to leave certain constructions out of the fragment. However, it is the point of this section that ignoring quotation not only helps to exclude a significant body of evidence, but may also miss an important generalisation which can be captured by existing semantic apparatus. Furthermore, there is an intuitive motivation for following this path in the obvious fact that mention must itself be regarded as a form of use, and should therefore be explained *somewhere* in a theory of language.

So, what happens to indexicals falling within quotation marks? Consider the sentences (22) and (23).

- (22) Barry said I am a Scot
- (23) Barry said "I am a Scot"

On a naive view of quotation, if I utter (22) and (23), *I* refers to me in the first utterance, but to Barry in the second. (23) represents a clear example of an indexical failing to act as an unbound indexical⁸. Notice, however, that Principle 1 is not contravened in this case: *I*

⁸ If Barry were to say "I said 'I am a Scot'", the second *I* would be related to the speaker, as normal. It is assumed in what follows that although temporal, personal and locational indexicals within quotation marks can sometimes pick out their standard referents, this cannot be because they are unbound after all (ie by being assigned their referents at the same point in the semantic structure as the assignment of values to variables). Naturally, an explanation of these cases would have to be supplied eventually.

than by the overall context of use. Nonetheless, what is significant is that *I* is no longer identified with the speaker of the whole utterance of (23): Principle 2 has failed completely. Examples of bound indexicals can be multiplied. For instance:

- (24) Fiona said Alex will be here tomorrow
- (25) Fiona said "Alex will be here tomorrow"

In (24), *tomorrow* plays its normal semantic role; its value will be the day after the day on which (24) is uttered. In (25), by contrast, there is no such relationship between *tomorrow* and the time at which (25) is uttered. Indeed, in general, for any temporal indexical under quotation, the indexical does not assume a value relative to speech time.

Doubtless there are many possible formal explanations for this fact: they may invoke the distinction between use and mention, or the notion of character-operation, or some other mechanism. But whatever the reason for the peculiar behaviour, it remains the case that *I* in (23) and *tomorrow* in (25) still have semantic content, for intuitively, the two utterances portray Barry and Fiona as standing in relationships towards expressions which are not meaningless pieces of script; the indexicals have some semantic content, even though it is not their usual content. In other words, even though *tomorrow* isn't related to the day after the day on which (25) is uttered, it is related to the day after the day of Fiona's reported utterance.

Bearing jointly in mind the old proverb (19) and the remarks concerning character-operators above, there is a natural temptation to explain the binding of indexicals in cases like (19) and (21) by assimilating these to quotation. So: can (19) and (21) be treated in terms of direct speech reports? Perhaps they are elliptical forms of (26) and (27) respectively:

- (26) "Never put off until tomorrow what you can do today"
- (27) "Don't put off until tomorrow what you can do today"

Certainly, the quotation marks would shift the reference of the indexicals, thereby permitting binding, and proverbs could thus be explained away as expressions which have the semantic status of reported speech, without the orthographic marks typical of that construction. There are, however, five reasons why such a conclusion would be premature.

First, there is no obvious reason why it should be assumed that proverbs are simply a degenerate type of reported speech, rather than taking proverbs and sentences containing quotation marks to be varieties of some more general construction.

Secondly, although there are some proverbs which are introduced by a form indicating reported speech (perhaps *Confucius say...* is of this type), most proverbs are unattributed, in the sense that there is no immediate indication that a use of a proverb involves quoting someone else. Now, if an utterance of (26) were really like an utterance of (25), we would be able to find the reference of *tomorrow* by identifying the actual utterance which our quotation reports. In the case of (26), it seems as though there is no suitable candidate. Thus, in the general case, even quotation marked proverbs will differ in this respect from ordinary sentences involving quotation.

Thirdly, there is a marked difference between cases such as (25) and those such as the putative (26). The difference has already been noted in passing: Principle 1 completely fails in (26), but operates, to an extent, in (25). While it is possible to account for the reference of *tomorrow* in terms of the subject of the main clause of (25), there is no such entity to appeal to in (26) or (27). This can be explained in the following way. Unlike an utterance of (25), an utterance of the proverb (19) is supposed to apply for all times, not just for the occasion of utterance. (21), meanwhile, has two readings, one of which has the same universality as (19), the other of which applies only on the occasion of utterance, like (25). As a result, in (19) and the first reading of (21), the reference of *tomorrow* is not merely shifted from its standard referent to another particular entity, which is what happens in going from (24) to (25). In fact, the occurrences of *today* and *tomorrow* apparently have no further function beyond specifying the relative space-time locations at which action is most desirable. There is a definite whiff of arbitrariness here, whereby any appropriately related pair of days may replace the day of speech and its successor. It is not dissipated by the apparent absence of quantifiers from (21) ⁹.

Thus quotation marks and proverbs, while they both tend to involve what we have termed bound occurrences of indexicals, differ considerably in the modifications they effect upon the semantic role played by the indexical expressions. Quotation marks raise the indexicals to a metalevel, so to speak, but allow them to refer to entities. Proverbs, by contrast, force the indexicals to become somehow arbitrary in their reference. To go a little further, it seems as though proverbial indexicals no longer have their standard function, although on the naive view of quotation, they still do semantic work: at the very least, *today* and *tomorrow* carry the information that tomorrow temporally succeeds today.

⁹ Indeed, when we render sentences such as (21) in the formalism introduced and elaborated in Chapters 3 and 4, we shall show that the generality of the first reading of (21) can after all be traced to an implicit temporal quantifier. But it was pointed out in section 2.7 that, even with this explanation in hand, the normally unbound nature of indexicals demands that the binding of indexicals involve more than straightforward temporal quantification. We return briefly to this point in section 2.10.

A fourth reason for refusing to collapse proverbs into quotation marked sentences involves their substitutability conditions. It seems clear that in general, sentences containing quotation marks will change in truth value unless the only substitutions allowed are of literal equivalents. Even taking into account the possibility of translating the quoted part of the sentence from one language into another, the substitutability conditions for quotation marked sentences are very strict. By contrast, although proverbs may not have truth values themselves, we may judge what substitutions will affect their appositeness. And in this case, sense identity of substitutions is probably enough. So the substitutability conditions for proverbs are looser than those for quotations. This being so, we may conclude that indexicals in proverbs are not just a variety of indexicals in quotations.

The fifth and final point counting against the assimilation of proverbs to quotation marked sentences arises from the following consideration. To dismiss proverbs as speech reports without the quotation marks is to neglect an important form of reported speech. In indirect speech reports, we often report utterances which originally involved indexicals, and we do so without using quotation marks. In certain cases, the report seems to involve bound indexicals. For instance, the indexical expression *tomorrow* does not seem to play its usual referential role in (28):

(28) Max always said that he would be rich tomorrow

(28) may perhaps be ambiguous: on one reading, an utterance of (28) on the 2nd of February might be taken to mean that Max always said that he would be rich on the 3rd of February. But on the other reading, the utterance would be taken to mean that, in the past, Max had (from time to time) claimed that he would be rich on the day succeeding his utterance. On the latter reading, *tomorrow* seems to be just as general as it is in the proverbs we have considered. In this respect, such quantified indirect speech reports resemble proverbs rather more closely than do quotation marked sentences.

The difference between the particular and general instances of bound indexicals will be examined in more detail in due course. Before doing so, however, the connexions between proverbs and imperatives will be followed up, in order to determine whether proverbs more closely resemble quotations or imperatives. In the course of the next section, more instances of bound indexicals will be discussed, and it should become possible to assess whether the quotational or proverbial bound indexicals are the central cases of direct reference failure.

2.9 Commands and Commandments

It was stated at the end of section 2.7 that utterances of sentences such as (19) and (21) resemble both quotations and imperatives. It is now time to study the relation between proverbs and imperatives. In passing, it should be noted that the imperative is a mood of a sentence, and most commonly occurs in those sentences used to issue commands, as in (29a); it stands in the same relation to command speech-acts as the indicative stands towards assertions and the interrogative stands towards questions. This does not mean, of course, that the relation between each of these moods and their characteristic speech-act is a necessary one: (29d), for instance, is in the imperative mood, but may be used to ask a question.

- (29a) Shut the door, Alex!
- (29b) Pour me a cup of coffee
- (29c) Put the block in the box
- (29d) Tell me who won the race

- (30a) Love your neighbour
- (30b) Thou shalt not kill

Similarly, (30b) is not in the imperative mood, but is commonly regarded as used to issue a command. Indeed, our interest does not lie in the imperative mood itself, but in the speech activities which are often, though not invariably associated with it. The sentences in (29) and (30) are mostly in the imperative mood; they differ considerably, however, in the interpretation of those indexicals which occur in them. All the indexicals occurring in (29) refer in the standard way: *me* refers to the speaker of the utterance in both (29b) and (29d), as Kaplan's theory of indexicals would predict. In the terms we have adopted, the occurrences of the indexicals in these examples are unbound.

Lyons (1977) argues that the distinctive feature of commands is that they are intended to be carried out by the person to whom they are addressed, unlike, for instance, demands, which may be carried out by the addressee or by some third party (Lyons (1977:747)). If it is assumed that a command is issued in order to ensure that a specific action is carried out in a space-time region close to (and temporally succeeding) the location of the utterance, then Lyons' claim amounts to a condition that the agent of that action should be a particular individual, namely the addressee of the command.

While the indexicals in the sentences in (29) act in the normal way, the status of the indexicals in (30) is less clear. On the one hand, the second person possessive *your* in an utterance of (30a) can, in the singular, refer to a single addressee of the utterance, or in the plural, refer to several listeners. On the other hand, it is far more likely that (30a) is uttered

with the intention of commanding (or at least, recommending) neighbourly love to be exhibited not just by a single hearer or group of hearers, nor just by those individuals nearby in space and time. The sentences in (30), then, have both “standard” and “moral” readings. We are concerned with them under their moral readings: (30a) commands love of everyone, regardless of their location in space and time. From this it follows that either (30a) contains something akin to an implicit universal quantifier ranging over individuals, or else an utterance of (30a) is used to issue a command which must be obeyed even by people who cannot possibly hear it. Since this latter possibility seems rather counterintuitive, we shall assume that if (19) is read as (31), then by analogy, (30a) may be read as (32):

- (31) For any day, act on that day, not the day after it.
- (32) For any person, they should love whoever their neighbour is.

The paraphrase is comparatively clumsy, but it carries the idea that (30a) is a commendation of a universal course of action, and indicates that the neighbour in question is that individual who is appropriately related to an arbitrary substitution instance of *person*. We are being told: pick a person, any person; that person should love their neighbour. As with (30a), so with (30b). Both (30a) and (30b) are unlike the commands in (29), in that they do not request (or prohibit) a specific action nearby in space-time of a specific individual. Instead, they call for actions of a certain kind to be carried out (or avoided) or for a disposition to be adopted (or avoided) by any individual who is capable of action throughout the space and time following the utterance.

The generality of an utterance of a sentence such as (30a) might be regarded as characteristic of moral commands as a whole. Arguably, the difference between categorical and hypothetical imperatives resides just in the generality of the command. Let us call utterances requiring action throughout an extended region of time and space by any hearer in that region *commandments*, thereby distinguishing them from those utterances which require a specific action of a specific individual, which we shall continue to term *commands*.

From the foregoing, it would be reasonable to conclude that while commands do not generally contain bound indexicals, commandments do seem to bind indexicals. If this is so, then (19) must be deemed to resemble the latter more closely than the former. Both commandments and proverbs create contexts in which indexicals become, so to speak, arbitrary in their reference. In this respect, proverbs are closer to commandments than quotation marked sentences, which merely shift the reference of an indexical from one specific individual to another. If a Fregean theory of quotation were to be adopted, we would say that we had shifted from an individual to a word; if a Quinean theory were preferred, we would

have to say that we had shifted from an individual to nothing at all. But whichever theory we adopted, we would still distinguish the “shift” cases from the general or arbitrary cases created by proverbs. And in the proverb, the reference of *tomorrow*, such as it is, is still to a day, not a word.

The indirect speech reports which contain bound indexicals also seem to have more in common with commandments and proverbs than they do with direct speech reports. It might perhaps be argued that proverbs may be reducible to commandments; however, this cannot be so. Commandments are addressed to everyone; proverbs, by contrast, though supposed to hold for all time, can be offered as pieces of good advice to particular individuals, without any suggestion that the utterer of the proverb commands or recommends a course of action for anyone except her immediate addressee. So, even if we are right in suggesting that proverbs resemble commandments, the bound indexicals are not thereby explained away. They occur in both contexts, but not simply because one context is a variety of the other.

2.10 Conclusion

We here survey the evidence supplied by indexicals, bound and unbound. In the first section, a new explanation for indexicals is proposed, and in the second, we sketch the outlines of the formal implementation of this proposal, which will be pursued in the rest of the thesis.

2.10.1 The Parametric Theory of Indexicals

This chapter has given us a clearer view of the indexical terrain. There are two types of occurrence for indexical expressions. First, there is the standard occurrence of indexicals in which they are context-sensitive and directly referential. Secondly, there is the rarer, but significant occurrence of indexicals in which they are not directly referential, and are context-sensitive in only a limited sense; here, the expressions do not play their normal semantic role. The former - indexicals unbound - were dealt with in sections 2.1 to 2.5 inclusive; the latter - indexicals bound - have been the objects of study in sections 2.6 to 2.9.

It should be noted that it is a significant decision to treat the bound indexicals as

“indexical” at all, since they lack the deictic features that indexicals are commonly taken to possess. However, since the actual word *now* is the same word inside and outside proverbial contexts, it has been assumed that what is required is a unified explanation of the behaviour of indexical expressions in the differing contexts, rather than two unconnected explanations of two separate lexical items *now_u* and *now_b*, the first unbound, the second not ¹⁰.

Given the decision to treat both unbound and bound indexicals, we must review the criterion by which we judge the adequacy of a theory of indexicals. Whereas before, a theory had to (i) cover the data, and (ii) distinguish indexicals from non-indexicals, now a theory must (i) cover the data, (ii) distinguish indexicals from non-indexicals, and (iii) relate unbound indexicals to bound indexicals.

Kaplan’s theory had two principles; when the domain of evidence includes both unbound indexicals and bound indexicals, his theory fails clause (i) by either the old or the new criterion; and while satisfying clause (ii), it fails clause (iii) of the new criterion.

The proposal we shall examine in this thesis is that indexicals should be represented by *parametric expressions*. The notion of a parameter has been used in many areas to mean many different things. We shall take a parameter to be an expression in a logical language whose value is assigned from extralinguistic context. In this sense, it is like neither constant nor variable, for while its value doesn’t depend on the interpretation of the model, it can’t take on a value which is unrelated to the extralinguistic context of utterance.

Unbound indexicals will be represented by parametric expressions; that is, expressions which contain explicit parameters. *Bound* indexicals will have their representations derived from the parametric expressions by the use of a substitution operator, which disconnects the indexical from the extralinguistic context, and allows the linguistic context to influence its value.

I claim that this way of formally understanding indexicals is adequate with respect to the revised criterion above. Let us call this way of understanding indexicals the *Parametric Theory of Indexicals*. The theory has two principles:

¹⁰ It is worth noting that Kaplan himself is willing to treat words such as *she* as having indexical and non-indexical readings. Further research would be necessary to determine whether or not his non-indexical *she* (as in *Mary said that she would be late*) could be regarded as indexical after all, but bound.

P-Principle	1:	Unbound indexicals act parametrically.
P-Principle	2:	Bound indexicals act non-parametrically.

P-Principle 1 subsumes Kaplan's two principles, for parameters are both context-sensitive and directly referential. In some contexts, indexicals have the role of parametric expressions; in others, they do not. The informativeness of the parametric theory depends on our ability to specify which contexts are covered by which principle. One of the consequences of the formal representation expounded in Chapters 3 and 4 is that we can represent those contexts where non-parametric indexicals occur.

As a matter of terminology, we shall often talk of parametric indexicals and non-parametric indexicals; this way of speaking is slightly sloppy, since it could be construed as conflating kinds of expressions with semantic roles. This issue did not arise for Kaplan, of course, since he believed that indexical expressions had only one semantic role, the role we call parametric.

To reiterate: under the parametric theory, all indexicals are context-dependent. Parametric indexicals depend on obvious features of extralinguistic context; non-parametric indexicals depend on features of the linguistic context, and indirectly on features of the extralinguistic context. In favour of the parametric theory elaborated here, we might say that it reaches parts of the context other theories could not reach. On a Kaplanian theory, unbound indexicals could be modelled, but the others could not; the parametric theory covers both bound and unbound indexicals because it allows the former to be sensitive to their linguistic context.

2.10.2 Remarks

Within the set of bound occurrences of indexicals there are two groups. First, there are those which seem to involve a general (or somehow arbitrary) interpretation of the indexical expressions therein. Secondly, there are those which allow a specific interpretation of the indexicals. The first group includes proverbs, aphorisms, certain types of indirect speech reports and what we have termed commandments¹¹. The second group includes sentences containing quotation marks. The mechanisms underlying these two groups will differ in some respects, but an outline of both should be forthcoming in Chapter 4. In that chapter, we shall concentrate in turn on two types of bound indexical from the first group:

¹¹ Lyons (1977) has a roughly coextensive group of utterances (it does not include bound indirect speech reports) which he terms *gnomic*, a useful catch-all (Lyons (1977:681)). Where this term is used hereafter, however, no commitment to Lyons' analysis is intended.

those occurring in indirect speech reports, in section 2, and those occurring in gnomic utterances, in section 5. We shall turn to bound indexicals from the second group only briefly, in section 6.

Up to now, it has been argued that the difference between indexicals bound and unbound cannot be explained by simply invoking temporal quantification. In fact, as we shall note, the framework we are about to adopt would open the possibility of rendering (21) with a temporal quantifier - that is, a referential quantifier over intervals. However, the original reason for resisting the immediate explanation still stands: in the case of the general bound indexicals, there must be some explanation for the defeat of direct reference by the temporal quantifier, and that explanation is not supplied by the notion of temporal quantification itself. That this is so is confirmed by the existence of particular bound indexicals such as those in quotation marked sentences. Suffice it for the moment that the large first group will be taken to include the paradigm cases of bound indexicals.

The difference between unbound (parametric) and bound (non-parametric) indexicals is fundamental, and is one which is apparent elsewhere in the semantics of natural language. It seems as though unbound indexicals are referring expressions, albeit of a rather special kind; by contrast, the paradigm bound indexicals have an arbitrariness, or generality, about them which makes them quite unlike standard referring indexicals. Unbound indexicals depend on extralinguistic context; bound indexicals depend more on linguistic context. A formal representation should lay bare the differing semantic roles played by indexicals: we are proposing that bound indexicals should be formally represented as expressions involving substitution, cutting them off from the context of speech; and it is this proposal which will be pursued in the next two chapters.

Finally, lest the discussion of gnomic utterances has been misleading, it is worth emphasising that we consider such single sentence bound indexicals in the hope that it will allow us to deal with more complex cases without appealing to principles of discourse organisation. So we would hope that the analysis we are about to present in IQ would deal with (33) now, and generalise to (34) later.

- (33) The reptiles have been told to confine their remarks to tomorrow's weather
- (34) The Prime Minister authorised the aid package. The team was now ready to take the initiative.

Chapter 3: Unbound Indexicals Incorporated

Chapter 2 laid out the phenomena that a successful theory of indexicals must account for. The parametric theory of indexicals claims that indexicals are parametric expressions; it will be argued in this chapter that the parametric theory can be successfully embedded in the model-theoretic framework of Richards (1986), and that within that framework, the theory can represent both unbound and bound indexicals. The former are relatively well understood, and they are the particular subject of this chapter. The latter are a newer discovery, but it will be shown in Chapter 4 that an adequate representation for them can also be provided, using the same apparatus. In this chapter, we shall first put in place the technical framework of Richards (1986), and then we shall discuss the existing treatment there of temporal indexicals, and the problems associated with it. Then the formal apparatus to be used for a new representation of indexicals will be introduced and demonstrated. With the treatment of indexicals adopted in section 3.5, it will be possible to represent them elegantly in a variety of contexts. Finally, the unexpected fruits of the parametric theory will be gathered in section 3.7, where some results of generalising the approach will be examined.

3.1 The IQ Framework

The framework espoused by Richards (1986) is a novel one; before discussing his existing treatment of indexicals, it would be well to put the major apparatus in place. In this section, we shall rehearse some of the leading ideas of the theory, its models and semantic clauses for the “non-temporal” section of the logical language, as well as the definitions of tenses and temporal quantifiers. The more ingenious aspects of the theory relating to parameters will be introduced later.

3.1.1 Leading Ideas

Richards (1986) proposes a framework for natural language semantics that contains several innovations. Some of these involve new mechanisms; others involve new combinations of old mechanisms. Because the framework is relatively new, it is worth taking a little time to note its leading ideas, before proceeding to describe the formal apparatus invoked and its accompanying semantics. There are essentially three issues to note.

First, it should be pointed out that the Richards framework is proposed as part of a formal semantics for a fragment of natural language containing a fairly wide variety of expressions used for talking about (and in) time. To this end, Richards supplies us with a formal language which is an extension of the first order predicate calculus. We are to view this language as an incomplete formalisation of a fragment of English; it stands in much the same relation to English as Montague's IL. Often in what follows, we shall talk of sentences of Richards' language as representations of natural language sentences. If an algorithm could be supplied for constructing these representations from natural language input, we could go further, and describe the representations as translations. This has not so far been done; whether it is possible is a moot point. For brevity, we shall often refer to Richards' logical language as "the language of IQ" or even, as "IQ" simpliciter ¹².

Together with the language of IQ comes a semantics. The model provides truth conditions for the standard quantifiers and for atomic and molecular sentences consisting of expressions referring to individuals and relations; it also provides truth conditions for sentences containing tense operators and other temporal expressions, which are treated as either sentential operators or sentential connectives. Richards does not specify a notion of logical consequence for a model; again, this should be forthcoming in time.

Secondly, Richards proposes a basic division between English tense and English temporal quantification. In the former category he includes the three traditional logical tenses, past, present and future; in the latter category he includes frequency adverbs such as *always*, *never* and *exactly twice*. He urges that the former category involves essential reference to speech time, whereas the latter does not. So, it is in this respect that Richards portrays himself as following Russell for tenses, and Prior for temporal quantifiers. The language Richards supplies is designed to reflect this distinction: tenses are deictic sentential operators, explicitly representing the Russellian view that tensed utterances are in some sense about the time of speech; meanwhile, the quantifiers refer to time, but not necessarily to speech time. We shall see in the next section just how IQ captures this difference. And while noting this basic difference, it is also worth observing that IQ is innovative in that it actually combines the Russellian and Priorian accounts within a single formal framework.

Thirdly, Richards bases his analysis on a distinction among English sentences with regard to their tense. He claims that where the sentence stands as a main clause it is tensed; where it stands as part of a subordinate clause or even a command, it is untensed. So (1) and (2)

¹² In Chapter 6, the syntax and semantics for a particular fragment of IQ are given. The language of the fragment is called IQ*, and is tailored for a comparison with a language based on a fragment of Kaplan's LD. IQ, as has been observed, may stand for more than one thing; the language of IQ can at least be thought of as a

contain the same sentence (3) as parts:

- (1) Marc plays golf
- (2) The doctor recommended that Marc play golf
- (3) Marc play golf

The difference between (3) in (1) and (2) is that in the former it occurs as part of a tensed clause, while in the latter it occurs as part of an untensed clause. In the former case, there is reference to speech time; in the latter, the untensed sentence makes no such reference.

So, there are three main ideas built into the IQ framework: first, it is to provide a model-theoretic representation of tense and temporal expressions; secondly, it distinguishes those temporal expressions which invoke reference to speech time from those which do not; thirdly, it distinguishes those sentences which involve reference to speech time from those which do not. The difference between the two types of sentence is, as we shall see, explained by the privileged role of tense.

3.1.2 Models and Tenses

In this section we'll give the models for the language of IQ, the semantic clauses for the "non-temporal" section of the language, and the definitions for the tenses.

First, then, a model for the language is a quintuple $\langle D, W, I, <, f \rangle$ such that

- (4) D, W and I are nonempty disjoint sets to be understood respectively as the set of possible objects, possible worlds and intervals of moments of time. Worlds and times have canonical names in the object-language.
- (5) The relation $<$ is a partial ordering on I , the set of intervals. It is glossed as the "earlier than" relation. For intervals i and j , $i < j$ iff all the moments in i are earlier than all the moments in j .¹³
- (6) f is a function that assigns a suitable intension to each nonlogical constant of the language, such that
 - (a) If b is a name, $f(b)(w,i)$ is an entity d of D only if for all subintervals j of i $f(b)(w,j)$ is also d .
 - (b) If r is an n -ary relation, $f(r)(w,i)$ is a subset d of D^n . And if j is a subinterval of i , then $f(r)(w,j)$ includes $f(r)(w,i)$.
 - (c) If c is a nonlogical constant and i a moment of time in I ,

¹³ To make $<$ a primitive relation on intervals, more conditions than this are in fact required. Alternatively, we could use moments in the models, and define intervals and the "earlier than" relation subsequently. Cf van Benthem's (1983) *The Logic of Time* for possible solutions.

$f(c)(w,i)$ must be defined.

Now, the truth clauses for the expressions of IQ are such that the definition of truth will yield the following homogeneity property for boolean combinations of primitive, untensed sentences.

- (7) An untensed sentence will be true at an index (w,i) only if for all subintervals j of i the sentence is true at (w,j) .

Where A and B are taken to be any sentences of the language, and M any model, the basic truth clauses are as follows. Richards allowed the possibility of truth-value gaps; we will not, so there is no need to cater for them in the clauses.

- (8a) An atomic sentence consisting of an n -ary relation R_n and n terms a_1, \dots, a_n is true in M at (w,i) if the sequence $f(a_1)(w,i), \dots, f(a_n)(w,i)$ belongs to $f(R_n)(w,i)$; it is false at (w,i) if the given sequence does not so belong.
- (8b) $(A \text{ and } B)$ is true in M at (w,i) if both A and B are true in M at (w,i) ; it is false at (w,i) if either A or B is false at (w,i) .
- (8c) $(A \text{ or } B)$ is true in M at (w,i) if either A or B is true in M at (w,i) ; it is false at (w,i) if both A and B are false at (w,i) .
- (8d) *Not* (A) is true in M at (w,i) if A is false in M at (w,i) ; it is false at (w,i) if A is true at (w,i) .

Now, $A(b/x)$ is the sentence which results from A by replacing all the free occurrences of x by a name b which does not already occur in A . M^b is a model which is like M except possibly for what the function f assigns to b . The standard quantifiers *Every* and *Some* are defined as follows:

- (8e) *Every* x (A) is true in M at (w,i) if $A(b/x)$ is true at (w,i) for every M^b ; it is false at (w,i) if $A(b/x)$ is false at (w,i) for some M^b .
- (8f) *Some* x (A) is true in M at (w,i) if $A(b/x)$ is true at (w,i) for some M^b ; it is false at (w,i) if $A(b/x)$ is false at (w,i) for every M^b .

With the semantics for the “non-temporal” expressions of the language in place, we may now define the tense operators in the following way. Up to now, the metavariable A ranged over all the sentences of the language; for the tense operators, its domain is restricted to the *context-free* sentences of the language. Context-freeness is a crucial concept, which we examine in more detail in relation to the parametrization of indexical expressions. Now, all the tense operators have a common form which can be represented as $Q_{(v,t)}$, with Q having PRES, PAST and FUT as substitution instances. Where A and B are sentences, A is said to be *context-sensitive* if it has the form $Q_{(v,t)}B$ or contains a subformula of this form. Context-freeness is then defined as follows.

- (9) A is context-free just in case it is not context-sensitive.

We can now say that an operator $Q_{(v,t)}$ applied to a context-free wff gives a context-sensitive wff; and applied to a context-sensitive wff, it gives a non-wff. Now to the tenses, which are to be read indefinitely; g_c is the possibly partial function that assigns values to the deictic parameters v and t relative to a context c .

- (10) $PRES_{(v,t)}$ A is true in a model M at a world-interval index (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and A is true in M at (w,i) ; it is false in M if either $w \neq g_c(v)$ or $i \neq g_c(t)$ or A is false in M at (w,i) .
- (11) $PAST_{(v,t)}$ A is true in a model M at (w,i) if $w=g_c(v)$, $i=g_c(t)$ and there is an interval $j < i$ such that A is true in M at (w,j) ; it is false at (w,i) if either $w \neq g_c(v)$ or $i \neq g_c(t)$ or for all $j < i$, A is false at (w,j) .
- (12) $FUT_{(v,t)}$ A is true in M at (w,i) if $w=g_c(v)$, $i=g_c(t)$ and there is an interval j such that $i < j$ and A is true in M at (w,j) ; it is false at (w,i) if either $w \neq g_c(v)$ or $i \neq g_c(t)$ or for all j such that $i < j$, A is false at (w,j) .

Given that tenses are syntactically constrained to apply only to context-free sentences, tense iteration is ruled out. It should be obvious, however, that we may wish, on occasion, to embed one tense operator within another. It is for this very reason that the operator G is introduced. G is treated in some detail in section 4 of this chapter; it is there that its vital role should become apparent, and it is there that the possibility of using G in conjunction with indexical expressions is first formally raised.

3.1.3 Propositions

To understand the denotations given to the linguistic expressions of IQ, it is useful to discuss the role of propositions in Richards (1986) by way of a number of examples. In this brief introduction, we shall trade on a pretheoretical notion of propositional content ("what was said" in an utterance), and suggest how it might be characterised in the IQ framework. The basic division at the denotational level of IQ is between value-free propositions and value-specific propositions¹⁴. The former are expressed by untensed sentences, such as those occurring in propositional attitude contexts and other subordinate clauses. The latter are expressed by normal, tensed sentences. The sentences (13) and (14) express

¹⁴ Richards has emphasised in conversation that the distinction is merely a term of art; we look at the differences in greater detail in section 1 of Chapter 5. There, we will also be careful to distinguish the proposition *expressed* by an utterance from the proposition *denoted* by it; for the time being, we can afford to equivocate.

value-specific and value-free propositions respectively:

- (13) Nick swims
- (14) Nick swim

The proposition expressed by the tenseless (14) picks out those moments of time at which Nick has the property of swimming. An actual utterance of (14) does not assert that the proposition expressed is true at the time of utterance. At most it can be read as saying “there are times at which Nick swims”. By contrast, the proposition expressed by the tensed sentence (13) picks out a particular time and says something about it. Specifically, an actual utterance of (13) asserts that a proposition is true at the time of utterance. The proposition asserted to be true is not the proposition expressed by (13), but the value-free proposition expressed by (14). Thus, (13) can be read as saying “this time is one of the times at which Nick swims”. If a sentence has a tense, it doesn’t just say something; it says something **about** the time of utterance. With the formal apparatus of IQ in place, it is possible to provide representations for the two sentences (13) and (14); they are given in (15) and (16) respectively.

- (15) $PRES_{(v,t)}$ (Nick swim)
- (16) (Nick swim)

It should be noted that (15) is the representation of the **sentence** (13), not of a particular utterance. If (13) is uttered at a particular time and place (w,i) , then the parameters v and t are assigned those specific values.

The utterance of (13) at (w,i) expresses the proposition that the value-free proposition expressed by (14) is true there. It is worth noting two points at this stage: first, Richards discusses his propositions in terms of intensions, but this need not mean that we aren’t able to express Russellian concerns in the framework; secondly, given specific values for v and t , (15) not only formally represents an utterance of the natural language sentence (13), but also denotes the proposition expressed in that utterance. We shall return to these observations in Chapter 5. The proposition represented in this way by (15) is the intension which takes only the world-interval pair (w,i) to true, if it takes any pair to true. The intension will be true at (w,i) , by the definition of the present tense operator, only if the intension denoted by (14) is true at (w,i) . The value-specific proposition bears a close relation to the truth-value of the utterance. For an utterance at (w,i) , there are just two possible value-specific propositions. If the utterance is true, then the proposition expressed is the value-specific proposition which delivers the value *true* for the index (w,i) only. If the utterance is false, then the proposition expressed is the value-specific proposition which delivers the value *false* for all indices. Metaphorically speaking, it seems that there’s a truth for every

time and place, but only one falsehood for them all.

There is, of course, a problem lurking here, and it is one which Richards addresses. Suppose that (13) is true in the model at (w,i) ; now suppose that the cotemporal utterance of the sentence (17) is also true at (w,i) .

(17) Alex lifts weights

If this is so, then the representation (15) of (13), and the representation (18) of (17) will denote the same (value-specific) proposition.

(15) $PRES_{(v,t)}$ (Nick swim)

(18) $PRES_{(v,t)}$ (Alex lift weights)

Clearly, the value-specific proposition expressed by the utterance of (13) cannot be thought of as registering “what was said” in that utterance; that is, it does not convey the information content of the utterance. This is because the value-specific proposition, but not the content, of (13) is shared by (17). The IQ solution, of course, is to identify the content of the utterance with the value-free proposition which that utterance asserts is true with respect to (w,i) . The value-free proposition denoted by (16) is distinct from the value-free proposition denoted by (19) (which the utterance of (17) asserts is true at (w,i)).

(19) (Alex lift weights)

These propositions are distinct in a given model, and their information content will not usually be the same. It will be shown in Chapter 4 that IQ not only distinguishes the content conveyed in utterances of tensed sentences; it also distinguishes the content of indirect speech reports. In other words, it can apparently discriminate among the propositions expressed by all context-free sentences of the language of IQ. With this idea of the semantic entities in mind, let us return to the linguistic expressions of IQ.

3.1.4 Other Temporal Expressions

Richards provides truth clauses for a number of other temporal expressions. In this section we shall mention in turn his definitions for a perfective aspect operator, three temporal quantifiers and one temporal connective. First, then, (20) is his definition of the aspectual operator HAVE; it invokes the notion of an anchor, defined in (21).

- (20) HAVE (A) is true in a model M at (w,i) if there is an interval j which is anchored to i such that for some subinterval k of j A is true in M at (w,k); it is false at (w,i) if there is no j anchored to i such that for some subinterval k of j A is true at (w,k).
- (21) i is anchored to j if j is a final segment of i.

Treating indexicals seriously will allow us to simplify considerably our treatment of perfective aspect; we consider the matter at some length in section 7 of this chapter.

Richards defines three temporal quantifiers in his paper; they are *always*, *never* and *exactly twice*. Like the tenses, these operators are indexical, in that the domain of temporal quantification is determined by context. The function g_c assigns an interval to the parameter r, relative to context. Unlike the tenses, however, the temporal quantifiers bear no special relation to speech time; it is for this reason that they do not contain an instance of the parameter t in their form: $g_c(t)$, it will be recalled, is speech time. We discuss the difference at greater length in the sections of this chapter dealing with parametrization. The quantifiers are defined in terms of the notion of a cover. There are those who are dissatisfied with this notion (defined in (23)); suffice it to say that the analysis of indexicals proposed in this chapter and the next does not depend crucially on the quantifiers being rendered in terms of covers. If it should become apparent that the definitions of the quantifiers should change, indexicals would not stand in the way of such a change, nor would they be affected by it.

- (22) ALWAYS_r (A) is true in a model M at (w,i) if $i = g_c(r)$ and there is a cover P of $g_c(r)$ such that for each p in P, A is true in M at (w,p); it is false at (w,i) if $i \neq g_c(r)$ or there is no such cover.
- (23) A set of intervals P is a cover for an interval i if the elements of P are mutually distinct (non-overlapping) subintervals of i whose "sum" is identical to i.

The other quantifiers, NEVER_r and TWICE!_r have structurally similar definitions; we shall provide their truth clauses where necessary. Richards defines only one temporal connective: *when*. He allows that in natural language, *when* has more than one sense, whilst maintaining that the case sense of *when* is primary. It is simple also to give clauses for the natural language expressions *before* and *after*.

The mechanisms discussed in the last few pages are the basis of the IQ framework; however, we have left out two major aspects of the theory. First, we have not yet given the treatment of temporal referring expressions such as dates and indexicals; secondly, we have not yet discussed the existing uses of G. It is now possible to address these issues: the former, in particular, will be approached in the next section. The desirability of

systematically distinguishing dates from indexicals will be a central concern.

3.2 Richards' Treatment of Indexicals

Richards (1986) provides semantic clauses for two indexical expressions: *yesterday* and *then*. Each is treated as a noun, which together with a preposition forms a sentential operator. Where A is a context-free sentence, (24) and (25) give Richards' definitions.

- (24) ON yesterday (A) is true in a model M at (w,i) if i is a subinterval of yesterday and A is true in M at (w,i); it is false at (w,i) if i is not a subinterval of yesterday or A is false at (w,i),
- (25) AT then (A) is true in a model M at (w,i) if i=then and A is true at (w,i); it is false at (w,i) if i≠then or A is false at (w,i),

Richards states that these clauses are in fact definition schemas, because the indexicals admit of alternative interpretations. Presumably, this must be read as a claim that indexicals are context-sensitive (on Kaplan's sense of the term), and that the referent of an indexical varies, depending on the context of use. To illustrate the behaviour of indexicals in the system, it is only necessary to unpack the truth-conditions for (27), the representation of (26).

- (26) Donald arrived in London yesterday
 (27) PAST_(v,i) [ON yesterday (Donald arrive in London)]

(27) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (28) is true at (w,j).

- (28) ON yesterday (Donald arrive in London)

According to (24), (28) is true at (w,j) if j is subinterval of yesterday and (29) is true at (w,j).

- (29) Donald arrive in London

Clearly, there is an unreduced indexicality in the truth-conditions; *yesterday* in the object-language is defined in terms of *yesterday* in the metalanguage. The problems attached to this representation of indexicals will be addressed in the next section.

3.3 Problems with Richards' Treatment of Indexicals

Richards' representation of temporal indexicals runs into problems in two major areas. First, it cannot adequately represent unbound indexicals (the first phenomenon of Chapter 2, exemplified in (30)). Secondly, it cannot represent bound indexicals (the second phenomenon of Chapter 2, exemplified in (31)).

- (30) It will soon be the case that all that is now beautiful is faded
- (31) Max always said that he would be rich tomorrow

We shall deal with each of these problems in turn.

Indexicals are, in Kaplan's terms, both context-sensitive and directly referential. In our terms, they are parametric expressions. Kaplan isolated the two properties of indexicals which give rise to their unique behaviour, but failed to unify them. The essential point of the parametric theory of indexicals is that the properties of indexicals can be given a unified explanation by treating the indexical as a parametric expression. Both the directly referential and context-sensitive properties are possessed by expressions containing parameters. Their values are fixed for all the indices which can be invoked by the tense or modal operators of the language, but they are dependent on a function from aspects of the context of utterance to entities in the domain of the model.

As far as their representation is concerned, parametric expressions must be systematically distinguished from ordinary expressions, both referential and quantificational. Section 3.2 indicated the representation Richards gives to indexicals such as *yesterday*. It is significant that the schema he offers differs hardly at all from the representation he gives dates such as *1st April 1985*:

- (32) ON 1st April 1985 (A) is true in M at (w,i) if i is a subinterval of 1st April 1985 and A is true in M at (w,i); it is false at (w,i) if either i is not a subinterval of 1st April 1985 or A is false at (w,i), .

There is no distinction between this representation and that for the indexical given in section 3.2. The syntactic forms of the expressions are exactly the same. The truth clauses are exactly the same. Thus the existing representation does not distinguish unbound indexicals from other temporal expressions. Kaplan would regard this as a fundamental error, since it is a central contention of Kaplan (1977) that indexicals are logical words, and may in this respect be suitably contrasted with dates. In Richards' defence, it might be argued that he does maintain a distinction between dates and indexicals; namely, indexicals contain an unreduced indexical expression in their semantic clauses. In other words, he doesn't

distinguish dates from indexicals in the object-language of his version of IQ; but he does do so in its metalanguage. This is indeed the case, but it is not a cause for celebration. Trouble arises when an attempt is made to deal with utterances of sentences such as (33).

(33) John ate his breakfast tomorrow

The trouble with (33) is that there is mismatch between the interval specified by the tense and the interval specified by the indexical. So, it'd be nice if the semantic structure of (33) were such that (33) could never be true on any occasion of utterance. That is: we wish to account for the anomalousness of (33) by appealing to the fact that it cannot be true at a particular set of world-time indices. Hence we align ourselves with those who judge that tense/indexical interaction leaves (33) "pragmatically invalid" (cf Montague (1968:104-8), Thomason (1974:65-8), Dowty (1979:324-5)). In Chapter 6, we'll make precise the notions of validity and satisfiability which we trade on here. Suffice it that if our truth conditions for indexicals lead to contradiction for a sentence such as (33), they render it unsatisfiable. Now, (34) is the representation which Richards would assign to (33).

(34) $PAST_{(v,t)}$ [ON tomorrow (John eat his breakfast)]

(34) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (35) is true at (w,j) .

(35) ON tomorrow (John eat his breakfast)

(35) is true at (w,j) if j is a subinterval of tomorrow and (36) is true at (w,j) .

(36) John eat his breakfast

(36) is true at (w,j) if John eats his breakfast at that time. As it stands, the semantics of *tomorrow* leaves (34) satisfiable. The only constraints on j , the interval at which (36) is true, are that it be before speech time, and that it be a subinterval of tomorrow. The fact that tomorrow cannot be before speech time is not registered by the semantics: it is a matter of world knowledge or pragmatics. So (33) is not semantically barred, just "pragmatically" inadvisable. The blame for this lies with the unreduced indexical in Richards' representation of *tomorrow*. Nothing relates it to speech time, beyond the fact that the utterance and its evaluation via the semantic clauses are supposed to occur simultaneously, and the evaluator (or language comprehender) is supposed to know that his or her tomorrow is therefore the same as the tomorrow of the speaker of the utterance. Richards's semantics won't tell the language comprehender how to determine the reference of *tomorrow*; he trades instead on the metalinguistic understanding of the expression. Thus, if the velocity of communication is low, the wrong truth conditions will result. So, although it

ultimately distinguishes indexicals from dates, the unreduced indexical does so by moving an apparently semantic matter out of the domain of semantics.

To put the point another way, recall the revised criterion by which we judge the adequacy of a theory of indexicals. A theory must (i) cover the data, (ii) distinguish indexicals from non-indexicals, and (iii) relate unbound indexicals to bound indexicals. If we demand that the theory satisfy (ii) in the object-language, Richards (1986) is inadequate. If we are more generous, and allow a metalanguage distinction to suffice, then Richards fails criterion (i), in the sense that his semantics cannot exclude a formula that is intuitively unsatisfiable.

The underspecified indexical is unsatisfactory, then, and must be reduced. The means of reduction is at hand, and with it comes the possibility of systematically separating the indexicals from the dates, within the formal object-language. If an indexical is given a parameter in its representation, and that parameter is evaluated by the function g_c , troublesome instances of *tomorrow* are excluded semantically. The choice of parameter made in section 3.5 of this chapter allows this, and we return to (33) in section 3.6.1.

It was stated that the Richards representation runs into problems over both unbound and bound indexicals. We have seen why it has difficulties with unbound indexicals; its problem with bound indexicals arises because there is no way of representing indexicals as anything other than referring expressions which occur with prepositions to form sentential operators. In other words, the bound cases, which should be represented as being formed from the unbound indexicals in some way, cannot be captured at all. One way of treating bound indexicals is to assume that they have a variable within their form, which is available for binding. Richards allows no such structure in unbound indexicals, and as a result, there is no structure available to allow the formation of more complex expressions. By contrast, the parametric theory of indexicals would introduce enough structure to permit the formation of appropriate representations for bound indexicals. In fact, of course, the parametric representation of indexicals introduces not a variable, but a parameter. However, if there is an operator which includes parameters in its domain, then bound indexicals may be represented. There is indeed such an operator: *G*. In the next section, we shall sketch some background portraying the existing uses of *G* with respect to parameters.

3.4 The Formal Apparatus

The previous section showed us that we must adopt a representation of the indexical which gives it a parameter in its logical form. This for two reasons: first, it will allow the context-sensitive and directly referential nature of indexicals to be properly portrayed; secondly, it will allow bound indexicals to be represented, using the operator G to bind the parameters, thereby defeating direct reference (or parametricity). In the next section, we will consider what kind of parameter indexicals should receive, and what consequences such a choice will have for the theory. Before proceeding to innovation, however, it will be useful to sketch in some background by discussing the existing uses of G with respect to expressions with deictic parameters. In this section, therefore, we shall examine in turn the binding of t and v , and the binding of r .

3.4.1 Deparametrized Tenses

What kind of operator is G ? Richards (1986:171) refers to it as a quantifier, but under the circumstances, it is probably sufficient to think of it as a form of substitution operator: it replaces a linguistic expression with another linguistic expression formed by naming an entity from the domain. That said, however, we shall follow Richards' use of the term "binding" to describe what G does to a parameter in making it a position into which substitution can occur. The notion of binding, of course, does not presuppose the notion of quantification; after all, the lambda-operator binds without being a quantifier.

What, then, does G do? To answer this question, it is helpful to bear in mind the technical definition of G . Where w^* and i^* are the canonical names of the world w and interval i , G is defined as follows:

- (37) $Gv't'[A]$ is true in a model M at (w,i) if $A [w^*/v',i^*/t']$ is true in M at (w,i) ; it is false at (w,i) if $A[w^*/v',i^*/t']$ is false at (w,i) .

In order to illustrate the role which G already plays in the IQ framework, let us first examine what happens when a tense is deparametrized. Take the example (38), an adaptation from Kamp (1971:231-32). Richards (1986:148-50) convincingly shows that its representation must contain two tenses, the second of which must be deparametrized, on syntactic grounds. (39) is the representation for (38).

- (38) A prince was invested who would be king
 (39) $\text{Some } x [\text{PAST}_{(v,t)}[[\text{Prince}(x) \text{ and } x \text{ be invested}] \text{ and } [\text{Gv't'FUT}_{(v',t')} (x \text{ be king})]]]$

(39) is true in model M at (w,i) if there is some b in the model such that (40) is true at (w,i).

- (40) $\text{PAST}_{(v,i)}[[\text{Prince}(b) \text{ and } b \text{ be invested}] \text{ and } [\text{Gv't'FUT}_{(v',t')} (b \text{ be king})]]$

(40) is true at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is some j earlier than i such that (41) and (42) are true at (w,j).

- (41) Prince(b) and b be invested
 (42) $\text{Gv't'FUT}_{(v',t')} (b \text{ be king})$

(41) is true at (w,j) if b is a prince and is invested at (w,j). (42) is true at (w,j) if (43) is true at (w,j).

- (43) $\text{FUT}_{(w^*j^*)} (b \text{ be king})$

(43) is true at (w,j) if $w=g_c(w^*)$ and $j=g_c(j^*)$ and there is a k later than j such that (44) is true at (w,k).

- (44) b be king

G binds the parameters attached to the embedded tense operator, and thus ensures that instead of being evaluated relative to speech time, the future tense operator is evaluated relative to whatever time the past tense determines. So the future in question is not the future of an utterer of (38), but the future of the invested prince; nothing is said about the location of k relative to the speaker. G is the sole mechanism which can prevent a tense operator from being evaluated with respect to speech time; only G can force the future to be relativised to some time other than that at which the utterer of (38) speaks. We will examine an example in which an attempt is made to specify a relationship between the interval k and the speech time i in section 3.6.4. In the absence of further temporal adverbials, we may say that once G has done its work, the relation is left unspecified.

On a terminological note, we shall say that when G binds the parameters in an expression, that expression has been *deparametrized*. Occasionally, therefore, we shall state that an expression is *undeparametrized*, in that its parameters have been left alone, even though the expression occurs in a sentence containing a G-operator. An undeparametrized expression is a parametric expression sharing a sentence with at least one G-operator.

In the next section we shall examine the role of G in sentences containing more than one

temporal quantifier; this will help establish how it contributes to the process of unpacking truth-conditions in general; and it will also help prove that not all representations which contain two quantifiers but no *G* are ill-formed. This point will be crucial in our examination of *since*-quantifier interaction in section 3.7.

3.4.2 Quantifier-Quantifier Interaction

To represent correctly a sentence containing two temporal quantifiers, it is essential to capture any scope relation holding between them. In order to do so, it is necessary to invoke the operator *G*. However, it can be shown that, in some cases at least, a representation containing two temporal quantifiers, but no *G*, is semantically coherent (that is: it is not made unsatisfiable by the semantics of the IQ operators).

Exactly twice is defined as follows:

- (45) $TWICE!_r(A)$ is true in a model *M* at (w,i) if $i = g_c(r)$ and there is a cover *P* of $g_c(r)$ such that for exactly two elements p_1 and p_2 in *P* *A* is true at (w,p_1) and (w,p_2) and for any other cover *Q* of $g_c(r)$ and element *q* of *Q* if *A* is true at (w,q) then *q* is a subinterval of either p_1 or p_2 ; it is false at (w,i) if $i \neq g_c(r)$ or there is no cover *P* satisfying the indicated conditions,

Now take (46), for instance, and try the representations (47), (48), (49) and (50).

- (46) The postman always rang (exactly) twice
- (47) $PAST_{(v,t)}[ALWAYS_r[TWICE!_r(\text{the postman ring})]]$
- (48) $PAST_{(v,t)}[TWICE!_r[ALWAYS_r(\text{the postman ring})]]$
- (49) $PAST_{(v,t)}[ALWAYS_r[Gr'TWICE!_r(\text{the postman ring})]]$
- (50) $PAST_{(v,t)}[TWICE!_r[Gr'ALWAYS_r(\text{the postman ring})]]$

It will be seen that the correct representation for the intuitive reading of (46) is given by (49), and that if (46) can be read as saying "There have been two periods in the past during which the postman always rang", then (50) is the correct representation for such a reading. Both of these representations make use of the operator *G*. On the other hand, neither (47) nor (48) seem to correspond to any reading of (46). But while (47) is at least truth-conditionally coherent, (48) is not. The truth-conditions for each representation are as follows.



Option A

$$(47) \quad \text{PAST}_{(v,t)} [\text{ALWAYS}_r [\text{TWICE!}_r (\text{the postman ring})]]$$

(47) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (51) is true at (w,j) .

$$(51) \quad \text{ALWAYS}_r [\text{TWICE!}_r (\text{the postman ring})]$$

(51) is true at (w,j) if $j=g_c(r)$ and there is a cover P of $g_c(r)$ such that for all $p \in P$, (52) is true at (w,p) .

$$(52) \quad \text{TWICE!}_r (\text{the postman ring})$$

(52) is true at (w,p) if $p=g_c(r)$ and there exists a cover Q of $g_c(r)$ such that for exactly two elements q_1 and q_2 in Q , (53) is true at (w,q_1) and (w,q_2) , and for any other cover R of $g_c(r)$ and element r of R , if (53) is true at (w,r) , then r is a subinterval of either q_1 or q_2 . Since $p=g_c(r)=j$, $p=j$. Under this option, ALWAYS_r is vacuous, but harmless.

$$(53) \quad \text{the postman ring}$$

Option B

$$(48) \quad \text{PAST}_{(v,t)} [\text{TWICE!}_r [\text{ALWAYS}_r (\text{the postman ring})]]$$

(48) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (54) is true at (w,j) .

$$(54) \quad \text{TWICE!}_r [\text{ALWAYS}_r (\text{the postman ring})]$$

(54) is true at (w,j) if $j=g_c(r)$ and there exists a cover P of $g_c(r)$ such that for exactly two elements p_1 and p_2 in P , (55) is true at (w,p_1) and (w,p_2) , and for any other cover Q of $g_c(r)$ and element q of Q , if (55) is true at (w,q) , then q is a subinterval of either p_1 or p_2 .

$$(55) \quad \text{ALWAYS}_r (\text{the postman ring})$$

(55) is true at (w,p_1) if $p_1=g_c(r)$ and there exists a cover R_1 of $g_c(r)$ such that for all $r_1 \in R_1$, (53) is true at (w,r_1) . Since $p_1=g_c(r)=j$, $p_1=j$. Now, (55) is also true at (w,p_2) if $p_2=g_c(r)$ and there exists a cover R_2 of $g_c(r)$ such that for all $r_2 \in R_2$, (53) is true at (w,r_2) . Since $p_2=g_c(r)=j=p_1$, $p_2=p_1$. This, however, is impossible, since p_1 and p_2 are disjoint elements of P . Thus, Option B is semantically incoherent, in that its truth conditions are contradictory. It will be unsatisfiable.

Option C

(49) $PAST_{(v,t)} [ALWAYS_r [Gr'TWICE!_r, (the\ postman\ ring)]]$

(49) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (56) is true at (w,j) .

(56) $ALWAYS_r [Gr'TWICE!_r, (the\ postman\ ring)]$

(56) is true at (w,j) if $j=g_c(r)$ and there exists a cover P of $g_c(r)$ such that for all $p \in P$, (57) is true at (w,p) .

(57) $Gr'TWICE!_r, (the\ postman\ ring)$

(57) is true at (w,p) if (58) is true at (w,p) .

(58) $TWICE!_{p^*} (the\ postman\ ring)$

(58) is true at (w,p) if $p=g_c(p^*)$ and there exists a cover Q of $g_c(p^*)$ such that for exactly two elements q_1 and q_2 in Q , (53) is true at (w,q_1) and (w,q_2) , and for any other cover R of $g_c(p^*)$ and element r of R , if (53) is true at (w,r) , then r is a subinterval of either q_1 or q_2 . This option correctly captures the preferred reading of (46).

Option D

(50) $PAST_{(v,t)} [TWICE!_r [Gr'ALWAYS_r, (the\ postman\ ring)]]$

(50) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (59) is true at (w,j) .

(59) $TWICE!_r [Gr'ALWAYS_r, (the\ postman\ ring)]$

(59) is true at (w,j) if $j=g_c(r)$ and there exists a cover P of $g_c(r)$ such that for exactly two elements p_1 and p_2 in P , (60) is true at (w,p_1) and (w,p_2) , and for any other cover Q of $g_c(r)$ and element q of Q , if (60) is true at (w,q) , then q is a subinterval of either p_1 or p_2 .

(60) $Gr'ALWAYS_r, (the\ postman\ ring)$

(60) is true at (w,p_1) and (w,p_2) if (61) is true at (w,p_1) and (62) is true at (w,p_2) .

(61) $ALWAYS_{p_1^*} (the\ postman\ ring)$

(62) $ALWAYS_{p_2^*} (the\ postman\ ring)$

(61) is true at (w,p_1) if $p_1=g_c(p_1^*)$ and there exists a cover R_1 of $g_c(p_1^*)$ such that for all $r_1 \in R_1$, (53) is true at (w,r_1) . Now, (62) is true at (w,p_2) if $p_2=g_c(p_2^*)$ and there exists a cover R_2 of $g_c(p_2^*)$ such that for all $r_2 \in R_2$, (53) is true at (w,r_2) . So, (50) will be true if

there were exactly two intervals in the past during which the postman always rang.

It should now be obvious that (49) represents the intuitive reading of (46), and that (50) is a representation of the other possible reading of (46). Significantly, from our point of view, (48) has turned out to possess inconsistent truth-conditions, while (47), though not a representation of (46), is both syntactically and semantically possible. (47) can be read as saying “The postman rang twice” in a redundant fashion. This demonstrates that certain orderings of temporal quantifiers are permissible, even without the use of the operator *G*. It should be noted, of course, that logical forms containing such undeparametrized temporal quantifiers would not normally be taken to adequately represent sentences of English. However, the fact that they are not excluded by IQ’s semantics will be a crucial ingredient in the representation of the sentential operator *since* in conjunction with temporal quantifiers such as *exactly twice*.

3.5 Parametrization

It was decided in section 3.3 that indexicals would be parametrized; that is, the old representation would be replaced by a new one containing an occurrence of a parameter. In section 3.4, we examined instances of parameter-binding which involved the three parameter types *v*, *t* and *r*. In this section, we must determine which type of parameter indexicals need. As far as parameter-binding goes, that whole topic will effectively be deferred to Chapter 4, where the choice made in this section can be finally vindicated.

In the Richards (1986) system, there are two types of temporal parameter, labelled “*t*” and “*r*”. The former appear as part of the tense operators, the latter as part of temporal quantifiers. Assuming that we wish to represent indexicals without introducing a new type, a choice must be made between *r* and *t*.

3.5.1 The Parameter *r*

Is the parameter for indexicals *r*? Although *r* is only used in the original IQ system for temporal quantifiers, there is no reason why there should not be singular deictic temporal expressions, with the parameter *r* attached. According to Richards, *v* and *t* are “the only parameters to be styled as context-sensitive”¹⁵. From this, it would be natural to argue in

the following way. First, a sentence containing an instance of the parameter t would be context-sensitive, and therefore unsuitable material for a tense operator (or indeed, any temporal operator), because the operators are defined as taking context-free sentences as their domain. Secondly, indexicals must occur inside tensed sentences; therefore indexicals cannot invoke the parameter t . The only alternative is the parameter r , therefore, indexicals should be represented with the parameter r attached in their form.

However, such a conclusion cannot be correct, because it misconstrues the point of distinguishing r from t . t is the parameter which the function g_c takes to speech time. In other words, its value is assigned from context, and that value is the time of the utterance. Uttering a tensed sentence, a speaker has no choice over the value of $g_c(t)$. By contrast, r is the parameter which g_c can take to any deictically appropriate interval. The value is indeed assigned from context, but need have no relation to speech time whatsoever. The difference is that in this case, the speaker has a choice about the value of $g_c(r)$. In this respect, r resembles Kaplan's true demonstratives rather than his pure indexicals. For two reasons, r must be the wrong parameter for indexicals, and t the right one: first, indexical expressions such as *yesterday*, *now* and *next year* have referents which are necessarily related to speech time; secondly, a speaker has no choice about their reference. Thus, we must consider in more detail what happens if we use the parameter t .

3.5.2 The Parameter t

If the parameter is t , then *yesterday* would be represented as "*yesterday_t*" with the truth clause in (63).

- (63) ON *yesterday_t* (A) is true in a model M at (w,i) if i is a subinterval of the day before the day of $g_c(t)$ and A is true in M at (w,i) ; it is false at (w,i) if i is not a subinterval of the day before $g_c(t)$ or A is false at (w,i) .

To see that this representation gives the correct truth-conditions for a sentence, consider an utterance of the sentence (64), which is represented by (65).

- (64) Sue phoned yesterday
 (65) $PAST_{(v,t)}$ [ON *yesterday_t* (Sue phone)]

(65) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such (66) is true at (w,j) . Note that, as usual, the speech time i is the value of $g_c(t)$.

¹⁵ Footnote 7 Richards (1986). Note that Richards' use of the term does not coincide with Kaplan's.

(66) ON yesterday_t (Sue phone)

(66) is true at (w,j) if j is a subinterval of the day before the day of g_c(t), and (67) is true at (w,j).

(67) Sue phone

So, (64) is true if Sue phoned at some time on the day before the day of the utterance of (64). This is just as it should be. However, recalling the argument in the previous section, it might be claimed that (65) cannot be the correct representation for (64), because (65) is actually semantically ill-formed. If the presence of the parameter t makes a sentence context-sensitive, then the past tense operator cannot apply to (66) to give (65). If the representation of *yesterday* is correct, we must alter the sentence to which the tense applies in order that it is context-free. Using G to deparametrize the t attached to "yesterday", the resulting representation for (64) is (68):

(68) PAST_(v,t) [Gt'[ON yesterday_t, (Sue phone)]]

This would be true at (w,i) if w=g_c(v) and i=g_c(t), as before, and there was a j earlier than i such that (69) was true at (w,j).

(69) Gt'[ON yesterday_t, (Sue phone)]

(69) is true at (w,j) if (70) is true at (w,j).

(70) ON yesterday_{j*} (Sue phone)

(70) is true at (w,j) if j is a subinterval of the day before the day of g_c(j*) and (67) is true at (w,j). But this is impossible, since g_c(j*) is simply j; thus (70) would be true if j is a subinterval of the day before the day of j, which cannot be. Deparametrizing t so that a tense operator can apply to a sentence containing an indexical will not do. And even if it could, it would defeat the whole point of parametrization, which was to portray the parametric nature of unbound indexicals while using G to capture bound indexicals; if unbound indexicals are not parametric, and if we have to use G before we even treat bound indexicals, we have failed badly.

3.5.3 Parameters and Context-Sensitivity

All is not lost. It is possible to retain the representation for *yesterday* suggested above, and maintain (65) as the representation for (64) if a little more attention is paid to the notion of context-sensitivity alluded to above. It was stated that v and t are the only context-sensitive

parameters. This is, however, a slightly sloppy way of speaking. By definition, for a sentence A,

A is said to be context-sensitive if it has the form $Q_{(v,t)}B$ or contains a subformula of this form. [Richards 1986:146]

Sure enough, v and t do appear in context-sensitive formulae; however, a sentence is only context-sensitive if it actually contains a formula of the form $Q_{(v,t)}$, where Q ranges over {PAST,PRES,FUT}. That is, a sentence is technically context-sensitive only if has an undeparametrized tense in it. An occurrence of t is not enough; it is not enough even if we allow $yesterday_t$ to be reconstructed as "ON $yesterday_{(\{ \}, t)}$ ", so that a sentence containing "yesterday" contains a subformula of the form $Q_{(v,t)}$. It is not enough, because a sentence is context-sensitive **only** if the Q in the subformula in question is one of PAST, PRES or FUT. Once the full implications of the definition of context-sensitivity are recognised, it becomes clear that (66) is context-free after all, so that the tense operator can apply to it without impediment. Of course, it also becomes clear that "context-sensitive" is a slightly misleading term, since it cannot really apply to terms which gain their referents relative to a context of utterance. It only applies to those terms (the tenses) which, as it were, force the evaluation of the sentence in their scope. Tenses are evaluation inducing, in that once one has been encountered, a sentence is pegged to an interval relative to which it must be evaluated. It is no coincidence that it is value-specific propositions (ie truths or falsehoods) that are expressed with tensed sentences, and value-free propositions (the content of the former) that are expressed in tenseless sentences. Nor is it any surprise that there can be no more than one undeparametrized tense in a sentence: after all, the sentence cannot be evaluated twice.

From the discussion in this section, it seems as though the right parameter for almost all temporal indexicals is t ; and this necessitates a more rigorous conception of context-sensitivity. The choice of parameter allows us to systematically distinguish indexicals from dates: the former are related to speech time, the latter are not. So the new representation makes the indexical/non-indexical distinction in such a way as to cover the data discussed in section 3.6.1 below; and in this it improves over the original IQ representation.

Schematically, the situation is as follows. (71a) shows the general form of AT with dates, (71b), the form of AT with indexicals; (72a) shows the form of ON with dates and (72b) the form of ON with indexicals; (73a) and (73b) show the form of BEFORE with dates and indexicals respectively. Where d is a schema for dates, and x_t a schema for indexicals,

- (71a) AT d (A) is true in M at (w,i) if $i=d$ and A is true in M at (w,i) ; it is false at (w,i) if either $i \neq d$ or A is false at (w,i) .
- (71b) AT x_t (A) is true in M at (w,i) if $i = \text{the } x \text{ relative to } g_c(t)$ and A is true in M at (w,i) ; it is false at (w,i) if either $i \neq \text{the } x \text{ relative to } g_c(t)$ or A is false at (w,i) .
- (72a) ON d (A) is true in M at (w,i) if i is a subinterval of d and A is true in M at (w,i) ; it is false at (w,i) if either i is not a subinterval of d or A is false at (w,i) .
- (72b) ON x_t (A) is true in M at (w,i) if i is a subinterval of the x relative to $g_c(t)$ and A is true in M at (w,i) ; it is false at (w,i) if either i is not a subinterval of the x relative to $g_c(t)$ or A is false at (w,i) .
- (73a) BEFORE d (A) is true in M at (w,i) if i is earlier than d and A is true in M at (w,i) ; it is false at (w,i) if either i is not earlier than d or A is false at (w,i) .
- (73b) BEFORE x_t (A) is true in M at (w,i) if i is earlier than the x relative to $g_c(t)$ and A is true in M at (w,i) ; it is false at (w,i) if either i is not earlier than the x relative to $g_c(t)$ or A is false at (w,i) .

Examples of these are the following:

- (74) ON tomorrow_t (A) is true in a model M at (w,i) if i is a subinterval of the day after the day of $g_c(t)$ and A is true in M at (w,i) ; it is false at (w,i) if i is not a subinterval of the day after $g_c(t)$ or A is false at (w,i) .
- (75) ON today_t (A) is true in a model M at (w,i) if i is a subinterval of the day of $g_c(t)$ and A is true in M at (w,i) ; it is false at (w,i) if i is not a subinterval of the day of $g_c(t)$ or A is false at (w,i) .
- (76) AT now_t (A) is true in a model M at (w,i) if $i = g_c(t)$ and A is true in M at (w,i) ; it is false at (w,i) if $i \neq g_c(t)$ or A is false at (w,i) .

It was stated above that t is the right parameter for almost all temporal indexicals: the only exception might be *then*. It might be argued that the choice of deictic referent is unconstrained by speech time; however, it might be that there is one constraint on the referent of *then*, and that is that it *cannot* be $g_c(t)$. If this were so, then even *then* would be properly represented with the parameter t attached to it. Having established the correct parametric representation for unbound indexicals, and thereby fixed upon the proper distinction between dates and indexicals, we shall proceed to represent unbound indexicals in a wide variety of contexts.

3.6 Representing Unbound Indexicals

In this section, a number of examples will be dealt with. First, it will be demonstrated that the representation chosen above not only captures the right truth conditions for utterances involving indexicals, but also blocks semantically utterances which would involve a mismatch of tense and indexical. Secondly, we shall treat an example similar to those in Chapter 2, in order to show that the parametric representation correctly portrays the maximal scoping unbound indexicals with which that chapter was in part concerned. Thirdly, an apparent case of indexical-tense mismatch will be treated. The solution adopted will be relevant to the discussion of certain indirect speech reports in Chapter 4. Lastly, we shall investigate an anomalous sentence, whose relative unacceptability can be traced to the role of the indexicals within it.

3.6.1 A Simple Example

A particular advantage of introducing parameters into the representation of indexicals can be discovered in the elegant exclusion of anomalous sentences. (77) is semantically coherent, in that its truth conditions are not contradictory; (33), however, is not coherent in this way.

- (77) John ate his breakfast today
(33) John ate his breakfast tomorrow

Let (78) represent (77):

- (78) $PAST_{(v,i)} [ON\ today_t (John\ eat\ his\ breakfast)]$

(78) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (79) is true at (w,j) .

- (79) $ON\ today_t (John\ eat\ his\ breakfast)$

(79) is true at (w,j) if j is a subinterval of the day of $g_c(t)$ and (36) is true at (w,j) .

- (36) John eat his breakfast

(36) is true at (w,j) if John eats his breakfast at that time.

In this case, all is well; the past tense can match up with an interval before the utterance, but on the same day. However, the tense and indexical are incompatible when the interval specified by the tense cannot include the interval specified by the indexical; in such cases,

a mismatch occurs. That this is so counts in favour of the chosen representation, because it means that the representation of an utterance of a sentence such as (33) cannot be made true. Let (80) represent (33):

(80) $PAST_{(v,t)}$ [ON tomorrow_t (John eat his breakfast)]

(80) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (81) is true at (w,j).

(81) ON tomorrow_t (John eat his breakfast)

(81) is true at (w,j) if j is a subinterval of the day after the day of $g_c(t)$ and (36) is true at (w,j).

(36) John eat his breakfast

Again, (36) is true at (w,j) if John eats his breakfast at that time.

Clearly, (33) must be semantically illegitimate, since the conditions that must be placed on j cannot be met. On the one hand, $i=g_c(t)$, and j is earlier than i. On the other, j is a subinterval of the day after the day of $g_c(t)$, so that j must be later than i. j cannot be both before and after i, and so (33) is incoherent. It was observed in section 3 of this chapter that examples such as (33) can only be blocked by Richards by using world knowledge. The parametric representation of indexicals, by contrast, blocks the examples via the semantics of the object-language expressions. Furthermore, the blocking, here described in terms of semantic incoherence or contradiction, is given an explicit characterisation in terms of unsatisfiability in section 5 of Chapter 6.

3.6.2 A More Complex Example

The parametric representation also captures examples such as (82), which are more complex than those mentioned in section 1 of Chapter 2. These are central cases of the primary scoping behaviour of indexicals, and present problems for any theory which doesn't give a special role to indexicals. Unbound indexicals cannot have their reference altered by intensional operators such as tenses; they are what Kaplan calls directly referential terms. In the parametric theory of indexicals, this behaviour is one aspect of parametricity: the referent of the indexical is independent of the model. To show that the representation is adequate, consider two possible representations for (82).

(82) Someone not now alive will be President

With (83), we try to represent (82) as containing a future tense with scope over the whole sentence. With (84), we allow a present tense into the representation.

- (83) *Some x* [FUT_(v,t) [(AT now_t [Not (x be alive)]) and (x be President)]]
 (84) *Some x* [[PRES_(v,t) (AT now_t [Not (x be alive)])] and [FUT_(v,t) (x be President)]]

Option 1

(83) is true in model *M* at (w,i) if there is some *b* in the model such that (85) is true at (w,i).

(85) FUT_(v,t) [(AT now_t [Not (x be alive)]) and (x be President)]

(85) is true at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a *j* later than *i* such that (86) and (87) are both true at (w,j).

- (86) AT now_t [Not (b be alive)]
 (87) b be President

(86) is true at (w,j) if $j=g_c(t)$ and (88) is true at (w,j).

(88) Not (b be alive)

(88) is true at (w,j) if (89) is false at (w,j).

(89) b be alive

There are two reasons why this representation cannot be correct: first, the time to which *now* refers is the future time of Presidency, and for that reason, (82) is represented as saying that an individual will be President and dead at the same time. Although this state of affairs is not unknown, it is not the intuitive reading of (82). Secondly, (83) is semantically incoherent, since $j=g_c(t)=i$, and *j* is also later than *i*, which is not possible.

Option 2

(84) *Some x* [[PRES_(v,t) (AT now_t [Not (x be alive)])] and [FUT_(v,t) (x be President)]]

(84) is true in model *M* at (w,i) if there is some *b* in the model such that (90) and (91) are both true at (w,i).

- (90) PRES_(v,t) (AT now_t [Not (b be alive)])
 (91) FUT_(v,t) (b be President)

(90) is true at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and (86) is true at (w,i).

- (86) AT now_t [Not (b be alive)]

(86) is true at (w,i) if $i=g_c(t)$ and (88) is true at (w,i).

- (88) Not (b be alive)

(88) is true at (w,i) if (89) is false at (w,i).

- (89) b be alive

Finally, (91) is true at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j later than i such that (86) is true at (w,j).

- (86) b be President

Option 2, with (84) as the representation of (82) is both semantically coherent and also intuitively correct, since *now* is still tied to speech-time. The price for this accuracy seems to be the introduction of an apparently redundant present tense operator outside the scope of the future tense operator; *and* is given wider scope than either operator. In fact, however, there is nothing to prevent a representation of (82) which simply places the indexical clause (86) as conjoined with the future tense clause (91). To be sure, such a representation would have to account for the status of the clause lying outside the scope of the assertive tense. For the time being, then, we shall take (84) as the proper representation of (82). It should be apparent that the parametric representation of indexicals can indeed cope with unbound indexicals.

3.6.3 The Present Future

There is a problem associated with the representation of the sentence (92):

- (92) Tom finishes his PhD next year

The sentence cannot be represented with a simple present tense operator, since this clashes with the obvious parametric representation of the indexical expression *next year*, given in (93).

- (93) ON next-year_t (A) is true in model M at (w,i) if i is a subinterval of the year after the year of g_c(t); it is false at (w,i) if i is not a subinterval of the year after the year of g_c(t).

On the other hand, to represent (92) with a future tense operator not only does violence to the syntactic present tense, but also conflates its representation with that of the distinct sentence (94):

- (94) Tom will finish his PhD next year

Given the need to capture (92), we have a problem; one way of solving that problem is suggested below. The commitment the solution brings with it is that, while they are represented differently, (92) and (94) are rendered truth-conditionally equivalent. It is still possible to argue that while (94) is a straightforward claim about an event that occurs later than the utterance, (92) is a more subtle assertion about a plan for the later time that is actually held now. (94), but perhaps not (92), would be falsified if no PhD were produced in the year after putative utterance. We suggest below that IQ can go a little way towards capturing this point.

So, one solution to the problem is to represent the main tense of the sentence as present, but to introduce an additional future tense within the representation. Naturally, to ensure syntactic well-formedness, it is necessary to deparametrize the inner tense. Thus, it is suggested that (95) portrays the form of (92).

- (95) PRES_(v,t) [Gv't'FUT_(v',t') [ON next-year_t (Tom finish his PhD)]]

(95) is true in model M at (w,i) if w=g_c(v) and i=g_c(t) and (96) is true at (w,i).

- (96) FUT_(w*,i*) [ON next-year_t (Tom finish his PhD)]

(96) is true at (w,i) if w=g_c(w*) and i=g_c(i*) and there is a j later than i such that (97) is true at (w,j).

- (97) ON next-year_t (Tom finish his PhD)

(97) is true at (w,j) if j is a subinterval of the year after g_c(t) and (98) is true at (w,j).

- (98) Tom finish his PhD

With (95) as the representation for (92), the indexical correctly locates the PhD completion within an interval later than the time of utterance, while at the same time maintaining the main tense of the sentence as present. That there should be a future tense lurking within the representation of (92) is perhaps a little surprising, but evidence from indirect speech reports indicates that this is indeed the case. Suppose that Ewan uttered the sentence (92)

in 1985. Late in 1986, Mary can report Ewan's utterance by uttering the sentence (99). She cannot report the original utterance by using the sentence (100), for that would not report what Ewan said.

- (99) Ewan said that Tom would finish his PhD this year
- (100) Ewan said that Tom finished his PhD this year

To report indirectly an utterance of a sentence such as (92), it is necessary to use a construction which will involve a future tense operator in its representation. That operator is redundant from the point of view of tense, but not from the point of view of indexicals, our primary concern. The intricacies of indirect speech reports will be examined at some length in Chapter 4; suffice it for the moment that our intuitive understanding of such reports tends to support the representation adopted here for sentences such as (92).

So, the remaining problem concerns the relation between (95) and the simple future sentence (94). If the representation is of a true utterance of (92), is (94) true as well? The answer is not clear. However, even if the present future sentence did imply the simple future sentence, it would be possible to mount a defence of the representation. We could argue that utterances of present future sentences are assertions about currently obtaining dispositions which happen to concern the future, whereas utterances of simple future sentences are assertions about properties of objects that need not obtain at the present time at all, dispositional or no¹⁶. This is certainly the case at the representational level. The main tense of a simple future sentence is $FUT_{(v,t)}$. We can interpret such an operator in the following way: "The present time is such that there is a later time at which the following value-free proposition evaluates to true". By contrast, the main tense of a present future sentence is $PRES_{(v,t)}$. That operator would be interpreted in this way: "The present time is such that the following value-free proposition evaluates to true here". The value-free proposition which then follows the tense operator is a bare proposition in the case of the simple future, and a proposition involving tense information in the case of the present future. So, the different types of sentence involve asserting that different (but related) propositions evaluate to true at different intervals. The truth-value of a given present future utterance may be the same as its simple future analogue, but we will reach that truth-value by a rather different route.

The distinction between simple future and present future is akin to the distinction between *de re* and *de dicto* in at least one important respect. In the *de dicto* reading of an alethic modality, we allow the modal operator to scope over an expression denoting an entire proposition; in the *de re* case, we pull some of the elements out of the propositional

expression, and give them maximal scope. In the present future, we allow a tense operator to scope over a complex context-free sentence; in the simple future, the tense information in that complex context-free sentence is abstracted, and given maximal scope. What makes a *de re* and a *de dicto* reading true may be the same, but it makes truth in different ways¹⁷. As we have just seen, this is also the case with our diverse futures. The issue of the relationship between the present future utterance and its simple future analogue may be murky, then, but it is no murkier than the relationship between *de re* and *de dicto*. A logic for the language of IQ may settle the question. In the meantime, we shall adhere to the representation of present futures adopted in this section, for two main reasons. First, it is structurally adequate. Secondly, it is compatible with the treatment of indirect speech reports adopted in section 1 of Chapter 4.

3.6.4 We Want The Prince

In section 2 of Richards (1986), there is a treatment of the two sentences (39) and (101). The analysis given seems to be successful; however, it is interesting to examine what representation could be given to the sentences we derive by adding *tomorrow* to each of them:

- (39) A prince was invested who would be king
- (101) A prince was invested who will be king
- (102) A prince was invested who would be king tomorrow
- (103) A prince was invested who will be king tomorrow

Neither (102) nor (103) can be read as meaning that the prince was invested tomorrow; so *tomorrow* cannot modify the main verb of either sentence. In both cases, *tomorrow* must be taken to locate the interval at which the prince becomes a king. But whereas this seems perfectly reasonable for (103), (102) has a rather anomalous feel to it. Why this should be is rather elegantly explained by the parametric theory of indexicals as embedded in the IQ framework. We may assume a representation of (103) which follows on from Richards' treatment of (101). And if *tomorrow* is truly an unbound indexical in (102), then by analogy with Richards' treatment of the non-indexical example (39), (102) would be represented by (104).

¹⁶ This is roughly what Dowty (1979:157) proposes, following Ellen Prince.

¹⁷ I am indebted to David McCarty for this observation. In a rather different framework, Tichy (1980:363) also trades on a temporal *de re/de dicto* distinction. We'll turn to some of his comments in section 3.6.4 below.

- (104) *Some x* [$PAST_{(v,t)}$ [[*Prince(x) and x be invested*] *and* [$Gv't'FUT_{(v',t')}$ [*ON tomorrow_t (x be king)*]]]]

(104) is true in model *M* at (w,i) if there is some *b* in the model such that (105) is true at (w,i) .

- (105) $PAST_{(v,t)}$ [[*Prince(b) and b be invested*] *and* [$Gv't'FUT_{(v',t')}$ [*ON tomorrow_t (b be king)*]]]

(105) is true at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is some *j* earlier than *i* such that (106) and (107) are true at (w,j) .

- (106) *Prince(b) and b be invested*
 (107) $Gv't'FUT_{(v',t')}$ [*ON tomorrow_t (b be king)*]

(106) is true at (w,j) if *b* is a prince and is invested at (w,j) . (107) is true at (w,j) if (108) is true at (w,j) .

- (108) $FUT_{(w^*,j^*)}$ [*ON tomorrow_t (b be king)*]

(108) is true at (w,j) if $w=g_c(w^*)$ and $j=g_c(j^*)$ and there is a *k* later than *j* such that (109) is true at (w,k) .

- (109) *ON tomorrow_t (b be king)*

(109) is true at (w,k) if *k* is a subinterval of the day after the day of $g_c(t)$ and (110) is true at (w,k) .

- (110) *b be king*

With this representation of (102), *b* is a king on the day after the day of speech. The representation is both syntactically well-formed and semantically satisfiable.

However, something has gone wrong: the truth-conditions for (102) are virtually identical to those for the obvious representation of (103). The only difference is that for (103), *k* would be unrelated to *j*, because its future tense, being undeparametrized, works off speech time, not the past time at which the prince was invested. The point is that the *tomorrow* ensures that *k* has the same location in both cases: the day after the day of speech. In (102), the indexical has interacted with the future tense underlying *would* in such a way as to override its connotations of a “past future”. If *tomorrow* cancels the *would* in this way, the anomalous feel of (102) is explained. Apart from anything else, no-one in a position to say (102) would say it; they would say (103). And no-one in a position to say (103) would say (102).

So, if *tomorrow* in (102) is just an unbound indexical, we can see why it seems strange. But there is another possibility. It might be that *tomorrow* is acting as a bound indexical, and cannot escape the influence of *would*. In this case, we would represent (102) with (111):

- (102) A prince was invested who would be king tomorrow
 (111) *Some* x [$PAST_{(v,t)}$ [[$Prince(x)$ and x be invested] and [$Gv't'FUT_{(v',t')}$ [ON tomorrow _{t'} (x be king)]]]]]

In (111), we find a deparametrized *tomorrow*, bound by the same G which binds the future tense. What is going on? (111) is true in model M at (w,i) if there is some b in the model such that (112) is true at (w,i) .

- (112) $PAST_{(v,t)}$ [[$Prince(b)$ and b be invested] and [$Gv't'FUT_{(v',t')}$ [ON tomorrow _{t'} (b be king)]]]]]

(112) is true at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is some j earlier than i such that (106) and (113) are true at (w,j) .

- (106) $Prince(b)$ and b be invested
 (113) $Gv't'FUT_{(v',t')}$ [ON tomorrow _{t'} (b be king)]

Again, (106) is true at (w,j) if b is a prince and is invested at (w,j) . On the other hand, (113) is true at (w,j) if (114) is true at (w,j) .

- (114) $FUT_{(w^*,j^*)}$ [ON tomorrow _{j^*} (b be king)]]]

(114) is true at (w,j) if $w=g_c(w^*)$ and $j=g_c(j^*)$ and there is a k later than j such that (115) is true at (w,k) .

- (115) ON tomorrow _{j^*} (b be king)

(115) is true at (w,k) if k is a subinterval of the day after the day of $g_c(j^*)$ and (110) is true at (w,k) .

- (110) b be king

The effect of binding the indexical with the operator G is to make the time at which b is a king fall within the day following the day on which he was invested. It is possible to take one of two positions concerning the relation between (102) and its supposed representation (111). First, it would be natural to maintain that (111) does not represent (102) at all; we could claim that *tomorrow* in (102) is unbound after all, and should be represented by a parametric expression, rather than the deparametrized representation in (111). On this account, (111) would more closely represent the sentence (116).

(116) A prince was invested who would be king the next day

Secondly, and more controversially, it is possible to argue that (111) does represent an unusual reading of (102). Under this interpretation, it would be necessary to supply a context in which the speaker deliberately uses the indexical in a non-standard fashion. Indeed, it is tempting to suggest that (111) represents both (102) and (116), the difference being a stylistic one only. That is: in certain cases of bound indexicals, we might see no semantic difference between the bound indexical and its non-indexical equivalent; the only difference being that the use of the bound indexical trades on the urgency associated with its unbound reading.

Naturally, it would be a mistake to conclude that such imaginative uses of indexicals should affect the parametric theory as it stands. The theory should be taken to account for as many uses of indexicals as possible, but it would be asking a little much to expect it to explain away imaginative discourse. We have given two readings for (102): in one *tomorrow* is unbound, and sounds anomalous taken with *would*; in the other, *tomorrow* is bound and sounds better with *would*, having the same semantic import as *the next day*. It is significant that in the latter case, we are driven to considering circumstances in which *tomorrow* is not taken to be evaluated relative to speech time. In this sense, the indexical is indeed bound, and an example of the type of expression to which Chapter 4 is devoted.

As we suggested, the binding in this case, if possible at all, is conceivable solely in virtue of an understanding of stylistic vividness. Kamp and Rohrer (1983:264-67) pointed to a number of discourse-based examples in which an indexical was used in this fashion, as one of the narrator's perspective-shifting tools. And Tichy (1980:364;fn 15) claims that the use of *tomorrow* in place of *the next day*, which in his terms constitutes a de dicto use of an indexical, can be justified if we regard the use as signalling an assimilation to an oratio recta report. We can say that the discourse examples of bound indexicals tend to arise when the speaker (or narrator) is trying to get the listener (or reader) to put themselves into the position of some individual under discussion. The point is: with the new representation of indexicals, we can give an appropriate semantic characterisation of these examples which makes clear their relationship to standard unbound indexicals. The question of indexicals in extended discourse is a topic to which we shall briefly return in Chapter 7.

Whatever we finally say about multisentence discourses, the curious status of utterances of sentences such as (102) should by now be clear; moreover, it should also be apparent that a parametric representation of indexical expressions helps to explain the anomalous nature of these utterances.

3.7 Consequences of Parametrization

In section 3.6 it was shown that the representation of parametric indexicals chosen in section 3.5 delivers the right truth-conditions for indexicals occurring in various contexts. Treating parameters seriously has proved to be the correct course as far as indexicals are concerned; moreover, the parametrization of indexicals helps to lay bare the structure underlying other temporal operators. In this section, a taxonomy of the temporal expressions of IQ will be elaborated; from this, it will be possible to discern relations hitherto unnoticed. In particular, a new representation for perfective aspect will be suggested, and this alternative representation will be tested by examining its interaction with a number of temporal operators.

3.7.1 A New Taxonomy

In Richards (1986), there is a variety of temporal operators: there are the three tenses, the temporal quantifiers such as ALWAYS_t and TWICE!_t, the sentential operators such as AFTER 1970, and ON yesterday, and there is perfective aspect. Richards observes that tenses and temporal quantifiers both involve quantification over intervals of time. He also notes that aspect, in the form of the operator HAVE, resembles these quantifiers, but is not fixed to speech time, in the way that tense is; nor does it seem to introduce its own domain of quantification. There are also other similarities obtaining among the various operators: for instance, both the dates and the indexicals which form parts of sentential operators are non-quantificational; they are rather like temporal singular referring expressions.

Taking these observations together, it is possible to distinguish the groups of IQ temporal expressions from one another only by asking at least three key questions about each expression. The most economic way of so doing involves the following questions. First, does the expression involve quantification over intervals of time? Secondly, does the expression involve deixis? This question can be answered by checking whether or not there is a parameter in the operator's representation. Thirdly, is the reference of the expression related in some way to speech time? This last question can be answered by determining whether there is ever a choice about the reference of the expression. A simple feature system can be derived to portray the relevant differences, and it is this which is used in Figure 1. If an expression is categorised as +Q, it involves quantification over intervals. If it is +P, it involves parameters; and if it is +S, the parameter would work off speech time (so it's *t* or *t'*, rather than *r* or *r'*).

Tense [+Q +P +S]	————>	Tenseless [+Q -P +S]
eg $FUT_{(v,t)}(A)$		$Gv't'[FUT_{(v',t')}(A)]$

Temporal Quantifiers [+Q +P -S]	————>	Depara'd Quantifiers [+Q -P -S]
eg $ALWAYS_t(A)$		eg HAVE (A)

Unbound Indexicals [-Q +P +S]	————>	Bound Indexicals [-Q -P +S]
eg $On\ tomorrow_t(A)$		$Gt'[On\ tomorrow_{t'}(A)]$

? [-Q +P -S]	————>	?? [-Q -P -S]
eg $On\ Monday_t(A)$		$Gr'[On\ Monday_{t'}(A)]$

Figure 1

Figure 1 helps to make the relations between the groups of temporal expression rather clearer. The arrow “————>” represents the deparametrization effected by the G-operator. Some of the picture is unsurprising: it is simply definitional that a deparametrized tense results from binding the parameters in the structure of a tense. Similarly, it is already a central hypothesis of the thesis that bound indexicals are formed from unbound indexicals by deparametrization. However, the fact that the aspect operator in Richards’ system should be treated as an example of a deparametrized temporal quantifier is a surprise. So too is the possible existence of a class of deictic expressions which do not have their reference fixed by the time of utterance. In the latter case, it would be interesting either to locate the natural language analogues of these suggested expressions, or to show why they do not exist in natural language. However, we shall concentrate on the former discovery for the rest of this section, since it offers the possibility of discerning further structure in a temporal operator already defined in the system.

3.7.2 Perfective Aspect

In the theory as it stands, Richards represents perfective aspect as the sentential operator in (20):

- (20) HAVE (A) is true in a model M at (w,i) if there is an interval j which is anchored to i such that for some subinterval k of j A is true in M at (w,k); it is false at (w,i) if there is no j anchored to i such that for some subinterval k of j A is true at (w,k),

However, there are three good reasons for replacing this definition. First, the taxonomy of temporal expressions derived above suggests that aspect should be analysed as a deparametrized temporal quantifier; this being so, a more transparent representation for aspect would be desirable. Secondly, the present definition introduces the notion of “anchoring”, which is not required anywhere else in the system; if aspect can be treated without using the apparatus of anchoring, this device can be declared redundant, and jettisoned. Thirdly, it is possible that the current definition actually generates the wrong truth-conditions for some sentences; this point could be examined in more detail by taking it in the context of the examples in section 3.7.3.

If aspect is to be analysed as a deparametrized temporal quantifier, it must be decided which quantifier is to be deparametrized to derive it. Recall the definition of the parametric quantifier ALWAYS_r:

- (22) ALWAYS_r(A) is true in a model M at (w,i) if $i=g_c(r)$ and there is a cover P of $g_c(r)$ such that for each p in P, A is true in M at (w,p); it is false at (w,i) if $i \neq g_c(r)$ or there is no such cover,

This is, so to speak, the temporal analogue of the universal quantifier \forall . It is simple to construct the analogue for the existential quantifier \exists . It is the quantifier SOMETIME_r, whose truth-conditions are given in (117).

- (117) SOMETIME_r(A) is true in a model M at (w,i) if $i=g_c(r)$ and there is a cover P of $g_c(r)$ such that for some p in P, A is true in M at (w,p); it is false at (w,i) if $i \neq g_c(r)$ or there is no such cover,

It is proposed that aspect be analysed as the deparametrized version of SOMETIME_r. Thus aspect will be rendered as Gr'SOMETIME_r, and the truth-conditions for aspect are given in (118). This would not really require a separate semantic clause, since G and SOMETIME_r are already defined.

- (118) $\text{Gr'SOMETIME}_r(A)$ is true in a model M at (w,i) if $i=g_c(i^*)$ and there is a cover P of $g_c(i^*)$ such that for some p in P , A is true in M at (w,p) ; it is false at (w,i) if $i \neq g_c(i^*)$ or there is no such cover,

This definition boils down to a claim that if “ $\text{Gr'SOMETIME}_r(A)$ ” is true at (w,i) , then A is true for at least one (not necessarily proper) subinterval of i . The difference between (118) and (117) is that there are more constraints on the truth of (117): while it is possible that $i \neq g_c(r)$, it is not possible that $i \neq g_c(i^*)$. In other words, the deparametrized quantifier cannot introduce a new domain of quantification; it only quantifies over the interval handed to it. So this new characterisation allows aspect to introduce only a limited amount of semantic structure to the truth conditions of an aspectual sentence. The difference between (118) and the old (20) is that while (118) quantifies over the interval handed to it, (20) effectively quantifies over a different interval. The notion of anchoring invoked in (20) ensures that if an interval is handed to HAVE, that interval is the final subinterval of another interval, which is the one we then existentially quantify over. In the case of the present perfect, our new representation of aspect takes the perfect interval to be the extended now; the old representation took the perfect interval to be some time before the extended now.

Interestingly, the weakness of SOMETIME_r helps to explain why sentences containing the quantifier NEVER_r are so similar in force to those containing *Not*, a fact which Richards (1986) discusses at length. He defines NEVER_r in the following way:

- (119) $\text{NEVER}_r(A)$ is true in a model M at (w,i) if $i=g_c(r)$ and there is no cover P of $g_c(r)$ such that for some p in P A is true in M at (w,p) ; it is false at (w,i) if $i \neq g_c(r)$ or there is a cover P of $g_c(r)$ such that for some p in P A is true at (w,p) .

We can do without this definition if NEVER_r is construed as *Not* SOMETIME_r . Under this construal, the similarity of *Not* and NEVER_r is easily explained. What is more, such a move would provide a natural treatment of the gnomic sentence (120), mentioned in Chapter 2:

- (120) Don't put off until tomorrow what you can do today

It was suggested there that this sentence might actually harbour an implicit temporal quantifier; we can now see that SOMETIME_r could be the quantifier in question. Taken together with the treatment of imperatives adopted in Chapter 4, this fact would allow us to assimilate sentences such as (120) to those containing an explicit temporal quantifier. Such a move would help to license the claim that unquoted bound indexicals tend to occur with a temporal quantifier.

In the meantime, the only price to pay for aspectual success is that we must allow that speech time has the property of an extended now, in that it may extend into the past some distance; there would also be an “extended then” in the case of the past perfect. Obviously, the distance into the past will be constrained by other elements of the sentence. In section 3.7.3, it will be shown that the new definition of aspect gets the right truth conditions in sentences containing other temporal quantifiers. Building on this, we shall then demonstrate that the new definition allows an explanation to be given for the ambiguity of sentences such as (121).

(121) I have lived in Edinburgh since 1970

3.7.3 Aspect-Quantifier Interaction

Richards mentions the example (122) in a footnote which discusses Tichy’s (1985) criticism of interval semantics. Tichy holds that aspect and temporal quantifiers will interact badly in a semantics based on intervals. Richards argues that his system captures the interactions correctly, but leaves the verification of his claim as an exercise to the reader. Treating aspect as a deparametrized temporal quantifier still captures those interactions; indeed it allows us to analyse them as merely a special case of the quantifier-quantifier interactions discussed in section 3.4. Since too much reader exercise can be a bad thing, we offer here two alternative representations for (122).

- (122) Jocelyn has visited London exactly twice
 (123) $PRES_{(v,i)} [Gr'SOMETIME_r, [TWICE!_r (Jocelyn \text{ visit London})]]$
 (124) $PRES_{(v,i)} [Gr'SOMETIME_r, [TWICE!_r, (Jocelyn \text{ visit London})]]$

The first representation gives the two temporal quantifiers different parameters, so that while the parameter attached to SOMETIME is bound by the operator G, the parameter attached to TWICE! is still a full parameter. The second representation allows the temporal quantifiers to share a parameter, and then binds that parameter with G.

Option 1

(123) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and (125) is true in model M at (w,i).

(125) $Gr'SOMETIME_r, [TWICE!_r (Jocelyn \text{ visit London})]$

(125) is true at (w,i) if (126) is true at (w,i).

(126) $\text{SOMETIME}_{i^*} [\text{TWICE!}_r (\text{Jocelyn visit London})]$

(126) is true at (w,i) if $i=g_c(i^*)$ and there exists a cover P of $g_c(i^*)$ such that for some $p \in P$, (127) is true at (w,p) .

(127) $\text{TWICE!}_r (\text{Jocelyn visit London})$

(127) is true at (w,p) if $p=g_c(r)$ and there exists a cover Q of $g_c(r)$ such that for exactly two elements q_1 and q_2 in Q , (128) is true at (w,q_1) and (w,q_2) , and for any other cover R of $g_c(r)$ and element r of R , if (128) is true at (w,r) , then r is a subinterval of either q_1 or q_2 .

(128) Jocelyn visit London

(128) is true at (w,q_1) and (w,q_2) just in case Jocelyn visited London during those periods.

Option 2

(124) $\text{PRES}_{(v,i)} [\text{Gr'SOMETIME}_r [\text{TWICE!}_r (\text{Jocelyn visit London})]]$

(124) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and (129) is true in model M at (w,i) .

(129) $\text{Gr'SOMETIME}_r [\text{TWICE!}_r (\text{Jocelyn visit London})]$

(129) is true at (w,i) if (130) is true at (w,i) .

(130) $\text{SOMETIME}_{i^*} [\text{TWICE!}_{i^*} (\text{Jocelyn visit London})]$

(130) is true at (w,i) if $i=g_c(i^*)$ and there exists a cover P of $g_c(i^*)$ such that for some $p \in P$, (131) is true at (w,p) .

(131) $\text{TWICE!}_{i^*} (\text{Jocelyn visit London})$

(131) is true at (w,p) if $p=g_c(i^*)$ and there exists a cover Q of $g_c(i^*)$ such that for exactly two elements q_1 and q_2 in Q , (128) is true at (w,q_1) and (w,q_2) , and for any other cover R of $g_c(i^*)$ and element r of R , if (128) is true at (w,r) , then r is a subinterval of either q_1 or q_2 .

(128) Jocelyn visit London

Again, (128) is true at (w,q_1) and (w,q_2) just in case Jocelyn visited London during those periods. Which of (123) and (124) is the correct representation depends on how much else is allowed to happen in the extended now. On the one hand, if we want to avoid the possibility that Jocelyn has visited London a third time, we might need Option 2 to rule out the

third visit. On the other hand, if we wish to give a semantic explanation for the anomaly of (132) compared with (133) (each uttered in 1986), we might prefer Option 1.

- (132) ?Einstein has visited Princeton
 (133) Princeton has been visited by Einstein

The pair of examples is due to Chomsky (1971). It is generally agreed that the reason (132) is odd lies in the fact that Einstein has been dead for some years, whereas Princeton still exists. It is tempting to account for this fact by introducing some restriction on the time over which the present perfect may extend. Given that both (132) and (133) carry the reading “visited at least once”, Option 1 already has the mechanism for capturing the suggested restriction: substituting a parametric $SOMETIME_r$ for $TWICE!_r$, we may take advantage of the deictic parameter to specify the range of the temporal quantifier. The obvious range in the case of (132) is Einstein’s life; and in (133), it is Princeton’s life. If this is so, then the natural representation following Option 1 would exclude (132) because Einstein’s life is not cotermporal with the extended now; (133), by contrast, will be permissible, because the extended now may be taken to coincide with the history of Princeton University. So the suggested representation for the perfect might help provide an account for an example which is generally taken to involve some notion of “current relevance”, or the presupposition that the time of speech falls within a particular period of time¹⁸.

3.7.4 *Since*

We have now seen how the revised definition of aspect captures the right truth-conditions in sentences containing other temporal quantifiers. We shall now provide another example of such interaction, involving the temporal expression *since*. This will serve a three-fold purpose: first, it will confirm the adequacy of the new analysis; secondly, it will enable the system to cover more data, without introducing any new operators; and lastly, it will help to explain the general ambiguity in sentences containing *since*.

Richards (1986) does not contain a representation for *since* treated as a sentential operator. However, Richards (1982) does, and it is given in (134).

- (134) *Since* 7.0 (A) is true in M relative to (w,i) iff the initial bound of i is 7.0
 and for every subinterval j of i, A is true in M relative to (w,j).

There are two apparent problems with this representation. First, it cannot explain why there are two readings of (121), one of which would be true even if the speaker had lived in

Edinburgh only intermittently after 1970, the other of which would only be true if the speaker had lived there continuously since 1970 ¹⁹.

(121) I have lived in Edinburgh since 1970

Secondly, according to Richards (1982), the representation cannot block sentences which involve *since*, but are not to be rendered as aspectual. In the latter case Richards suggests that a meaning postulate would be necessary to block such undesirable sentences. On the basis that meaning postulates are just as undesirable as the sentences which must be blocked, we shall attempt to treat these two points without invoking such magic.

It is proposed that "since d (A)" be represented as $[ALWAYS_r [AFTER\ d\ (A)]]$, where d is some date or indexical ²⁰. When the parameter r is matched to the interval after d, the correct truth conditions fall out. This representation will allow us to explain the ambiguity of *since* in sentences such as (121) between continuous and intermittent readings. The explanation trades on the relative scopes of aspect and *since*. (135) and (136) are intended to capture the intermittent and continuous readings respectively.

- (121) I have lived in Edinburgh since 1970
 (135) $PRES_{(v,t)} [ALWAYS_r [AFTER\ 1970\ [Gr'SOMETIME_r\ (I\ live\ in\ Edinburgh)]]]$
 (136) $PRES_{(v,t)} [Gr'SOMETIME_r\ [ALWAYS_r [AFTER\ 1970\ (I\ live\ in\ Edinburgh)]]]$

Option 1

(135) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and (137) is true in model M at (w,i).

(137) $ALWAYS_r [AFTER\ 1970\ [Gr'SOMETIME_r\ (I\ live\ in\ Edinburgh)]]$

(137) is true at (w,i) if $i=g_c(r)$ and there exists a cover P of $g_c(r)$ such that for all $p \in P$, (138) is true at (w,p).

(138) $AFTER\ 1970\ [Gr'SOMETIME_r\ (I\ live\ in\ Edinburgh)]$

(138) is true at (w,p) if 1970 is earlier than p and (139) is true at (w,p).

¹⁸ Cf for instance McCawley (1971:106-8)

¹⁹ Following McCawley (1971:104), these readings could be labelled Existential and Universal.

²⁰ This representation therefore has a suggestive similarity to the representation Tichy (1980:357) assigns to *ever since* within his transparent intensional logic. He too claims that the ambiguity can be explained by the interactions between the perfect and frequency adverbs; but his mechanism is rather different.

(139) Gr'SOMETIME_r (I live in Edinburgh)

(139) is true at (w,p) if (140) is true at (w,p) .

(140) SOMETIME_{p^*} (I live in Edinburgh)

(140) is true at (w,p) if $p=g_c(p^*)$ and there exists a cover Q of $g_c(p^*)$ such that for some $q \in Q$, (141) is true at (w,q) .

(141) I live in Edinburgh

Option 2

(136) $\text{PRES}_{(v,i)} [\text{Gr'SOMETIME}_r [\text{ALWAYS}_r [\text{AFTER 1970 (I live in Edinburgh)}]]]$

(136) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and (142) is true in model M at (w,i) .

(142) $\text{Gr'SOMETIME}_r [\text{ALWAYS}_r [\text{AFTER 1970 (I live in Edinburgh)}]]$

(142) is true at (w,i) if (143) is true at (w,i) .

(143) $\text{SOMETIME}_{i^*} [\text{ALWAYS}_r [\text{AFTER 1970 (I live in Edinburgh)}]]$

(143) is true at (w,i) if $i=g_c(i^*)$ and there exists a cover P of $g_c(i^*)$ such that for some $p \in P$, (144) is true at (w,p) .

(144) $\text{ALWAYS}_r [\text{AFTER 1970 (I live in Edinburgh)}]$

(144) is true at (w,p) if $p=g_c(r)$ and there exists a cover Q of $g_c(r)$ such that for all $q \in Q$, (145) is true at (w,q) .

(145) AFTER 1970 (I live in Edinburgh)

(145) is true at (w,q) if 1970 is earlier than q and (141) is true at (w,q) .

(141) I live in Edinburgh

Option 1 represents the weaker, intermittent reading of (121); for it to be true, we need only find subintervals at which (141) is true, within all subintervals of the interval since 1970. Option 2, on the other hand represents the stronger, continuous reading of (121); for this to be true, we must find (141) true throughout each of the subintervals of the interval since 1970. Thus, the representation of *since* chosen above interacts with the new representation of aspect in such a way as to explain the ambiguity of (121), and thereby to confirm the adequacy of treating aspect as a deparametrized temporal quantifier. There may be

those who are not certain that (121) is genuinely ambiguous; the next example should make it clear that it must be. Since *since* itself has a quantifier as part of its representation, the next example will actually invoke three temporal quantifiers for its representation.

3.7.5 *Since-Quantifier Interaction*

According to our analysis, (146) should be derivable from (121) simply by adding the temporal quantifier *exactly twice*:

(146) I have lived in Edinburgh exactly twice since 1970

It should be apparent that it would only make sense to add the quantifier in the first, intermittent reading of (121), while its addition to the second, continuous reading of (121) would be nonsensical. And, if the representation of aspect-quantifier interaction developed earlier in this section is adopted, it can be shown that these intuitions are accurately reflected by the logical forms derived from (135) and (136) by adding $TWICE!_r$ to each of them. The derivative of (135) is truth-conditionally coherent, whereas the derivative of (136) is not.

(147) $PRES_{(v,t)} [ALWAYS_r [AFTER\ 1970 [Gr'SOMETIME_r, [TWICE!_r (I\ live\ in\ Edinburgh)]]]]]$

(148) $PRES_{(v,t)} [Gr'SOMETIME_r, [TWICE!_r [ALWAYS_r [AFTER\ 1970 (I\ live\ in\ Edinburgh)]]]]]$

The reason (147) is coherent, but (148) is not lies in the fact that it is possible for the quantifiers $ALWAYS_r$ and $TWICE!_r$ to occur in just that order while sharing the same parameter r , but if their order is reversed while they still share the same parameter, contradictory truth-conditions are generated. This fact, it will be recalled, was established in section 4 of this chapter. The account also assumes that $TWICE!_r$ must immediately follow $SOMETIME_r$ in the logical form; and that this is correct ordering is demonstrated in the part of this section devoted to aspect-quantifier interaction. According to the discussion there, (150) is the representation for (149), which is obviously closely related to (146).

(149) I have lived in Edinburgh exactly twice

(150) $PRES_{(v,t)} [Gr'SOMETIME_r, [TWICE!_r (I\ live\ in\ Edinburgh)]]]$

3.7.6 *Since Without Aspect*

So the decisions that have been made at various points about various constructions interact nicely to provide a solution to the first of the problems facing the Richards (1982) analysis of *since*. Richards himself posed the second problem: how do we block sentences such as (151)?

(151) I was in the room since 9.00

Richards proposed that a meaning postulate would be needed to filter out such undesirables, since their representations were neither syntactically ill-formed nor semantically incoherent on his analysis. The alternative representation suggested in this section does not exclude such sentences either. However, this may not be such a bad thing. Intuitions about such sentences are not clear-cut; some informants find them both syntactically and semantically well-formed. Tichy (1980:357) maintains that it is simply a syntactic rule of English that his construction AFT, in the context of a present perfect sentence, comes over as *since*. For these reasons, it would perhaps be a mistake to try to block sentences such as (151) with any semantic barrier. And this is just as well, since the representation (153) which is assigned to (151) is the same as the representation assigned to (152). The only differences will be in the values chosen for the deictic parameters.

(152) I was always in the room after 9.00

(153) $PAST_{(v,t)}$ [$ALWAYS_r$ [$AFTER$ 9.00 (I be in the room)]]

Now, since (152) is perfectly acceptable in natural language, and since it currently shares a representation with (151), it follows that the latter should not be excluded on semantic grounds. From the point of view of language generation, it would be a matter of lexical choice as to which of (151) and (152) was used as the realisation of the structure (153), all other intervals being equal. From the point of view of comprehension, (151) is indeed comprehensible: it can be read as (152).

So, the wider use of parameters leads to a number of innovations: it is not simply indexicals which benefit from parametrization. When aspect is treated as a deparametrized temporal quantifier, it is possible to fit it into a more systematic approach to the language of IQ. Doing so is not only compatible with the evidence; it also helps to explain the subtle interactions between aspect and *since* which give rise to ambiguities, which can themselves be probed using the general apparatus of temporal quantification.

3.8 Conclusions

The parametric theory of indexicals can be embedded in the IQ framework provided by Richards (1986). It can formally represent unbound indexicals, distinguishing them from non-indexical expressions such as dates, while doing justice to the dual aspect of their parametric nature. Taking indexicals to be parametric expressions helps to explain how they interact with other parametric expressions such as tenses, and thereby render certain sentences unsatisfiable. In arriving at the correct representation, the true import of Richards' notion of context-sensitivity has been uncovered. In addition, taking parameters seriously has allowed structural uniformities to be uncovered that had hitherto gone unnoticed. In particular, the representation of aspect has been revised, and its interaction with a variety of expressions has been examined. The representation chosen has proved to be both supportable and fertile. Chapter 4 will show how it accommodates the mysterious cases of bound indexicals.

Chapter 4: Bound Indexicals Incorporated

This chapter deals with the incorporation of bound (or non-parametric) indexicals into the IQ framework. The previous chapter dealt with the issue of the representation of temporal indexical expressions in general, and unbound (or parametric) occurrences of indexicals in particular. Certain decisions were taken then concerning the nature of the representation which can only be vindicated now, by considering those bound indexicals which were introduced in Chapter 2. To show how such indexicals can be accommodated in the theory, it is necessary to mount a two-pronged attack. First, an examination of the role of propositions in indirect speech reports is required, in order to fix a representation for the first type of bound indexical. Secondly, it is necessary to consider how to represent both imperatives and conditionals, so that the second type of bound indexical can be treated. This chapter should show not only how to represent the binding of indexicals, but also how that binding comes about.

4.1 The Representation of Indirect Speech

There seem to be some problems lurking in the propositional undergrowth. One of these becomes apparent when an attempt is made to supply the truth conditions for an indirect speech report such as (1):

- (1) Sagan said that he needed a telescope

Richards (1986:174-7) discusses a similar example at some length, in order to explicate the equation of the value-free proposition with what is actually said. However, he never supplies truth conditions for the utterance, and it is this that we shall now attempt to do. Presupposing no particular analysis for the occurrence of the pronoun *he* in (1), we may take the representation of (1) to be (2), and then work out the conditions in the obvious way.

- (2) $PAST_{(v,i)}$ [Sagan say that $[Gv't'PAST_{(v',t')}$ (he need a telescope)]]

(2) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (3) is true at (w,j) .

- (3) Sagan say that $[Gv't'PAST_{(v',t')}]$ (he need a telescope)]

When is (3) true at (w,j) ? Presumably, it is true at that interval if Sagan stands in the relation of saying to the proposition whose name is given by (4).

- (4) that $[Gv't'PAST_{(v',t')}]$ (he need a telescope)]

Richards' view of propositions would dictate that (4) is the name of what was said at the interval. In other words, it is the name of the content of Sagan's utterance. More obviously, (3) is true at (w,j) if what Sagan said at (w,j) was the proposition represented by (5)

- (5) $Gv't'PAST_{(v',t')}$ (he need a telescope)

As far as the truth of (1) goes, this is all that matters. But if we want to find out whether what Sagan said was true or false, it is necessary to unpack the truth conditions for (5). Since truth is relativised to a model, world and interval, of course, the interval at which (5) is to be evaluated must be determined. Notice, of course, that (5), as a value-free proposition, does not come with its preferred time of evaluation "built in", as is the case with value-specific propositions. So, to find out whether the value-free proposition which corresponds to what Sagan said is true, we must supply an interval to the value-free proposition, and whatever interval seems most relevant to the truth of what was said, we shall call the *time of evaluation* ²¹. The obvious choice for the time of evaluation for (5) is j . j is the time of Sagan's speech; in what follows, we shall call the time of the reported speaker's utterance the *embedded speech time*. Now, (5) is true at (w,j) if (6) is true at (w,j) .

- (6) $PAST_{(w^*,j^*)}$ (he need a telescope)

(6) is true at (w,j) if $w=g_c(w^*)$ and $j=g_c(j^*)$ and there is a k earlier than j such that (7) is true at (w,k) .

- (7) he need a telescope

So what Sagan said is true if he needed a telescope at an earlier time than his utterance. Sagan would have said (8). Suppose, on the other hand, he had said (9).

- (8) I needed a telescope
(9) I need a telescope

If he had said (9), and (1) is used to report that distinct utterance, then (1) would have to be assigned the different representation (10).

²¹ This notion corresponds to the second element of the ordered world-time pair which functions as the circumstance-index in Chapter 6.

- (10) $PAST_{(v,t)}$ [Sagan say that [$Gv't'PRES_{(v',t')}$ (he need a telescope)]]

And the proposition which Sagan expressed would be that in (11).

- (11) $Gv't'PRES_{(v',t')}$ (he need a telescope)

What he said was true at (w,j) if (12) was true at (w,j) .

- (12) $PRES_{(w*,j*)}$ (he need a telescope)

(12) is true at (w,j) if $w=g_c(w*)$ and $j=g_c(j*)$ and (7) is true at (w,j) . So what Sagan said was true if he needed a telescope at the same time as he spoke, which is just as would be expected. However, the fact that instances of (1), with its embedded past tense, should be taken to be an adequate report of either (8) or (9) means that (1) is ambiguous, in the sense that it can be assigned the two truth-conditionally distinct representations (2) and (10). And if (1), with that embedded past tense, reports (9), then there may be a problem over the representation of (13).

- (13) Sagan said that he needs a telescope

Intuitively, a speaker could use (13) to indicate that her speech time falls within the time of Sagan's stated need. That is, without committing herself to the truth of Sagan's statement, she portrays the fact that the statement, if true, is still true at the time of her speech. This means that a reporter might portray a speaker as standing in the "says" relation to a proposition that would only be true at a time later than the embedded speech time. This being so, (13) cannot be represented by (10) if the truth conditions of what Sagan said are those which have been suggested. After all, what he said could be true at the time he spoke if he needed a telescope at that time, without any suggestion that it must still be the case at the time (13) is uttered. There are essentially three responses that can be made to this position.

First, it is possible to reject the claim that (10) fails to represent (13), and maintain that what has gone wrong can be traced to the attempt to give the truth conditions for what was said in terms of the time of the embedded speech. If the proposition is taken to be evaluated relative to the speech time of the whole utterance, then the truth conditions fall out correctly. However, if this is the case, then problems arise if (1) is a report of an utterance of (9), and (9) is taken to be represented by (10).

- (1) Sagan said that he needed a telescope
 (9) I need a telescope
 (10) $PAST_{(v,t)}$ [Sagan say that [$Gv't'PRES_{(v',t')}$ (he need a telescope)]]
 (11) $Gv't'PRES_{(v',t')}$ (he need a telescope)

(1) would be true if what Sagan said was the proposition represented by (11). What he said

would be taken to be true if it were true at the time of the utterance of (1), rather than at the time of Sagan's utterance of (9). This cannot be right, not least since it would imply that (1) and (13) are truth-conditionally equivalent. In response, an adherent of this position could hold that the difference between (1) and (13) lies not in their structure, but in the interval relative to which Sagan's proposition should be considered. For (1), the proposition should be evaluated relative to (w,j) . For (13), it should be considered relative to (w,i) . The problem with this response is that there is no indication as to when (w,i) should be used instead of (w,j) . The most obvious strategy to follow would be to use (w,j) in all cases, except when the tense of the subordinate clause is present, in which case it is necessary to switch to (w,i) . But this policy fails with sentences such as (14), when the *tomorrow* is seen as making more precise the time of speech, rather than the time of need.

(14) Billy will say that he needs the football tomorrow

Final discussion of the correct representation of this example, in which the indexical falls outside the scope of "says", will be deferred until the role of indexicals *inside* subordinate clauses has been illustrated.

Secondly, it would still be possible to maintain that (10) correctly represents (13), while claiming that (13) would only be true if j and i were sufficiently close together. Since there is nothing in the structure or the truth clauses to ensure this, such a claim represents an attempt to relegate the problem to pragmatics. Even if this second response did not suffer from the same problems as the first with respect to (14), it is not one that lies comfortably with the general approach of this chapter, which is to leave as little as possible to pragmatics.

Thirdly, it might be agreed that (13) is not properly represented by (10). Such a response would only be acceptable in tandem with an adequate alternative representation for (13). This last response is the avenue which we shall follow, for three reasons. First, the treatment of (13) will offer a solution which may be generalised to deal with other constructions. Secondly, the actual representation given for (13) will dictate the interval at which the value-free proposition is to be evaluated. Lastly, the solution will not run into any trouble over (14).

The first step towards deriving an adequate representation for (13) is to note the existence of other pairs of examples which have certain features in common with the pair (1) and (13).

- (1) Sagan said that he needed a telescope
- (13) Sagan said that he needs a telescope
- (15) Martin said that Marc would visit Glasgow tomorrow
- (16) Martin said that Marc will visit Glasgow tomorrow

The embedded tense of *need* seems as though it ought to be present in (13) and in the second reading of (1). Similarly, both (15) and (16) seem to require an embedded future tense in their representations. But if they share a representation, then there is again no immediate explanation for the difference in the English speech reports. The difference may be described in the following way: in the first member of each pair, the embedded tense seems as though it ought to be considered relative to the embedded speech time. In the second member of each pair, the embedded tense ought to be considered with respect to the embedding speech time, just like normal, unembedded tenses. To put the point a little more vividly, the former tenses are “dead”, as far as the reporter of the utterance is concerned; the latter tenses are, by contrast, very much “alive”. When a tense is dead, it bears no essential relation to speech time; when it is alive, the relation lives on, even in embedded contexts. So in both (13) and (16), the utterer of the indirect speech report is placing herself (not just the reported speaker) in some temporal relation to the individuals and relations mentioned in the report.

What, then, is the life support mechanism that keeps a tense alive, even after it has been embedded? The tense cannot still be fully parametric, since this is forbidden at both the linguistic and propositional level. An embedded tense cannot be fully parametric because tense iteration is explicitly ruled out of the language of IQ. This in turn corresponds to the fact that the function of a parametric tense is to convert a value-free proposition into a value-specific proposition; and the latter should not occur as part of an indirect speech report, since it is merely a (temporally relativised) truth-value. If speakers were related by the “says” relation to value-specific propositions, then indirect speech reports would merely report that speakers said truth-values; and that can’t be right.

A parametric representation cannot be used to provide life support for the tense. However, there is a possibility which is both syntactically and semantically admissible. With the resources of IQ, we may create tenses that are, so to speak, semi-parametric. In all the structures so far proposed, indirect speech reports have contained tenses that have both their parameters bound out by the G-operator. This is not the only possible state of affairs. If the world parameter is bound out by G, and the temporal parameter left free, we obtain a structure that is syntactically well-formed, in that “that” applies to a sentence of IQ that is by definition context-free; furthermore, the structure is also semantically admissible, since the proposition corresponding to what was said is still value-free, on the definition given

by Richards. It will be temporally specific, to be sure, but the discussion in Chapter 5 shows that it is not thereby a value-specific proposition.

Thus, we can now frame a proposal which will deal with pairs of sentences such as (1) and (13) or (15) and (16). Dead tenses should be represented in the logical form with fully deparametrized tense operators. Live tenses should be represented with semi-parametric tense operators. The former category includes the English past tense, where the original utterance being reported contained a present tense; and also the English future-oriented construction *would*. The latter category includes cases of the English present tense occurring within indirect speech reports, and cases of *will* occurring in those contexts.

To see that this proposal represents a reasonable solution to the problem presented by pairs such as (1) and (13), consider the representations assigned to these sentences by the proposal:

- (10) $PAST_{(v,i)}$ [Sagan say that $[Gv't'PRES_{(v',i')}]$ (he need a telescope)]]
 (17) $PAST_{(v,i)}$ [Sagan say that $[Gv'PRES_{(v',i)}]$ (he need a telescope)]]

The only difference between the representation (10) for the second reading of (1) and the new representation (17) for (13) is that in (17), only one of the parameters on the embedded tense is bound out by G. So we have provided a new representation of (13) to replace (10), but it is different in only a small respect. To see what a difference that difference makes, let's examine what is reported to have been said in each case. According to (10), what was said is the value-free proposition in (11); according to (17) (which represents a distinct utterance), what was said is the value-free proposition in (18).

- (11) $Gv't'PRES_{(v',i')}$ (he need a telescope)
 (18) $Gv'PRES_{(v',i)}$ (he need a telescope)

The two value-free propositions are true under different circumstances: the truth of (11) can be considered at any world-interval pair; (18) is temporally specific, and can be true at many world indices, but only one temporal index. To see that this is so, consider whether (18) is true at the speech time of (13), and at the time of Sagan's speech reported by (13). Let's look at the latter of these first. What would have to be the case for (18) to be true at Sagan's speech time (w,j) ? (18) is true at (w,j) if (19) is true at (w,j) .

- (19) $PRES_{(w*,j)}$ (he need a telescope)

(19) is true at (w,j) if $w=g_c(w^*)$, and $j=g_c(t)$. Now, the utterance of the sentence (13) was true if $i=g_c(t)$, and by the definition of the past tense operator, j is earlier than i . Thus, trying to make (18) true at (w,j) generates inconsistent truth-conditions. So, (18) cannot be

made true at (w,j) , the index at which Sagan himself spoke. On the other hand, it is simple to show that (18) can be made true at (w,i) , the time of the reporter's speech. In fact, this is the only temporal index at which the value-free proposition evaluates to true. So, on this account, the reporter is doing something rather sophisticated with (13): she is reporting Sagan's relationship to a proposition which can be true (if at all) only at the time of her speech. The reporter both records (a version of) the proposition Sagan expressed, and locates herself relative to that proposition.

It should now be apparent why embedding speech time is sometimes the place to find out whether what was said is true. When a tense is live, there is only one temporal index at which what was said is true: embedding speech time. In the normal case, when the tense is dead, what was said is less specific, and it makes sense to find out whether it was true at the time of the reported speech. So, with the representation for (13) proposed here, we do have a procedure for determining where to find out whether what was said is true. If the tense operator is rendered as deparametrized, then we consider what was said at (w,j) ; if the tense operator is semi-parametric, we can only consider what was said at (w,i) .

This solution to the problem of the present tense in (13) generalises to the apparently standard future tense in (16). The future tense operator in the representation of (15) will be deparametrized; the operator in the representation of (16) will be semi-parametric:

(20) $PAST_{(v,i)}$ [Martin say that $[Gv't'FUT_{(v',i')} [ON tomorrow_t (Marc visit Glasgow)]]]$

(21) $PAST_{(v,i)}$ [Martin say that $[Gv'FUT_{(v',i)} [ON tomorrow_t (Marc visit Glasgow)]]]$

The presence of the indexical " $tomorrow_t$ " in the context-free sentence contained in both representations does not disrupt the smooth analysis; again, a semi-parametric tense operator forces us to look at the truth value of what was said at the time of the utterance of the indirect speech report.

The introduction of semi-parametric tenses is, of course, quite compatible with the existence of examples such as (14).

(14) Billy will say that he needs the football tomorrow

In these cases, the embedded present tense is dead, not alive. So what is reported to have been said is to be evaluated at the time of Billy's speech, not at the time of the utterance of (14). We shall return to this example below. To summarise, it has been shown that we can deal with the embedded present tense of (13) by using a strategy which dictates in a

systematic manner the interval at which what is said is to be evaluated; thus, we have here a semantic explanation for the sequence of tense phenomena examined by Costa (1972). Furthermore, we have seen that the strategy generalises to cover other cases of embedded but living tenses; and happily, it can be demonstrated that sentences such as (14), which contains a dead present tense, can be represented in the obvious way.

We have assumed that when a tense is dead, the only interval relevant to determining the truth value of what was said is the embedded speech time. To show that this is so, it is necessary to consider indirect speech reports which contain indexical expressions. In so doing, we shall attempt to prove two points in turn. First, we will argue that temporal adverbs can be embedded within indirect speech so as to determine the time relative to which the value-free proposition is to be considered. Secondly, it will be shown that the temporal indexicals which determine the correct interval in these cases force the use of the embedded speech time at the expense of the embedding speech time.

- (22) Someone will say that Bush was a great President
- (23) Bush was a great President
- (24) Someone will say on 17th May 2000 that Bush was a great President
- (25) Someone will say that Bush was a great President on 17th May 2000

Does the temporal adverb in (25) modify the contained occurrence of (23) so that it is to be considered relative to 17th May 2000? Suppose it doesn't. If this were so, (25) could not be read as meaning that someone will assert (at some time after 2000) that Bush was a great President on the 17th of May, even if that date turns out to be Bush's moment of resolution and glory. So, on this analysis, (25) could only be read as (24).

By considering indirect speech reports which contain occurrences of temporal indexicals, however, it can be shown that such a supposition must be false.

- (26) Terry said that he would need a terminal tomorrow

Clearly, the *tomorrow* in (26) cannot be thought of as making the time of reported speech more precise, which is the function Richards (1986:177) assigns to the temporal adverb in (24). Rather, it modifies the value-free proposition to be considered, which is to be thought of as what Terry said. If (27) and (28) are rival representations of (26), it can easily be shown that while (27) is semantically coherent, (28) is not.

- (27) $PAST_{(v,t)}$ [Terry say that [Gv't'FUT_(v',t') [ON tomorrow_t (he need a terminal)]]]]
- (28) $PAST_{(v,t)}$ [ON tomorrow_t [Terry say that [Gv't'FUT_(v',t') (he need a terminal)]]]]

It should be noted, of course, that temporal indexicals can also be used to locate the interval of reported speech, as in (29).

- (29) Terry said yesterday that he would need a terminal tomorrow

An example such as (30) may therefore be ambiguous, and could be represented either as in (31) or (32).

- (30) Keith said that he would visit Cambridge yesterday
 (31) $PAST_{(v,i)} [Keith \text{ say that } [Gv't'FUT_{(v',i')} [ON \text{ yesterday}_t (\text{he visit Cambridge})]]]$
 (32) $PAST_{(v,i)} [ON \text{ yesterday}_t [Keith \text{ say that } [Gv't'FUT_{(v',i')} (\text{he visit Cambridge})]]]$

Thus, it has been shown that temporal adverbs can occur within the scope of the "says" relation. It is still necessary to prove that the interval at which what Keith said should be evaluated is the interval of embedded speech, and not the speech time for an utterance of (30). This can be done by unpacking the truth conditions for (31); this will also demonstrate that embedded indexicals are indeed semantically coherent. (31) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (33) is true at (w,j).

- (33) Keith say that $[Gv't'FUT_{(v',i')} [ON \text{ yesterday}_t (\text{he visit Cambridge})]]$

(33) is true at (w,j) if Keith stands in the relation of saying to the value-free proposition named in (34).

- (34) that $[Gv't'FUT_{(v',i')} [ON \text{ yesterday}_t (\text{he visit Cambridge})]]$

What Keith said at (w,j) was the value-free proposition represented by (35).

- (35) $Gv't'FUT_{(v',i')} [ON \text{ yesterday}_t (\text{he visit Cambridge})]$

(31) is true at (w,i) if what Keith said at (w,j) was (35). It is now possible to show that the embedded indexical uniquely fixes j as the interval for determining the truth value of what Keith said. Suppose that the interval is (w,i). Then (35) is true at (w,i) if (36) is true at (w,i).

- (36) $FUT_{(w*,i')} [ON \text{ yesterday}_t (\text{he visit Cambridge})]$

(36) is true at (w,i) if $w=g_c(w')$ and $i=g_c(i')$ and there is a k later than i such that (37) is true at (w,k).

(37) ON yesterday_t (he visit Cambridge)

(37) is true at (w,k) if k is a subinterval of the day before the day of g_c(t). But this cannot be so, since it has already been stated that k is later than i, which is the value of both g_c(i*) and g_c(t). Thus, what Keith said is semantically incoherent, if its truth is to be determined relative to (w,i). On the other hand, if (35) is evaluated relative to (w,j), then the conditions are more favourable: (35) is true at (w,j) if (38) is true at (w,j).

(38) FUT_(w*,j*) [ON yesterday_t (he visit Cambridge)]

(38) is true at (w,j) if w=g_c(w*) and j=g_c(j*) and there is an l later than j such that (37) is true at (w,l). (37) is true at (w,l) if l is a subinterval of the day before the day of g_c(t), and (39) is true at (w,l).

(39) he visit Cambridge

So, if the value-free proposition which represents what Keith said is evaluated relative to (w,j), the conditions which result are those which accord with intuition. What Keith said is true if he spoke before the occasion of his visit to Cambridge, and that visit took place the day before the utterance of (30) which reports his utterance.

Thus it can be seen that the occurrence of temporal indexicals within indirect speech reports counts in favour of using (w,j) in examples as diverse as (1) and (29). What is more, the occurrence of indexicals *outside* the scope of the "says" relation counts against the use of embedding speech time as the interval for evaluation of the temporally neutral value-free proposition expressed. One reading of examples such as (14) sees the indexical *tomorrow* as locating the interval of the reported utterance. (40) is a representation of this reading²².

(14) Billy will say that he needs the football tomorrow

(40) FUT_(v,t) [ON tomorrow_t [Billy say that [Gv't'PRES_(v',t') (he need the football)]]]]

(40) is true in model M at (w,i) if w=g_c(v) and i=g_c(t) and there is a j later than i such that (41) is true at (w,j).

(41) ON tomorrow_t [Billy say that [Gv't'PRES_(v',t') (he need the football)]]

(41) is true at (w,j) if j is a subinterval of the day after the day of g_c(t) and (42) is true at (w,j).

²² Note that the present tense in this example cannot be live, and so should not be represented with a semi-parametric PRES. Such a representation would denote a distinct, temporally specific value-free proposition. Indeed, (46) could be used to report someone's expressing that proposition.

(42) Billy say that $[Gv't'PRES_{(v',t')}]$ (he need the football)]

(42) is true at (w,j) if what Billy says at (w,j) is the value-free proposition represented in (43).

(43) $Gv't'PRES_{(v',t')}$ (he need the football)

If we want to find out whether what Billy says at (w,j) is true, we must evaluate the value-free proposition. It is simple to show that the interval at which (43) should be evaluated is not the embedding speech time (w,i) . If it were, then (43) would be true at (w,i) if (44) is true at (w,i) .

(44) $PRES_{(w^*,i^*)}$ (he need the football)

(44) is true at (w,i) if $w=g_c(w^*)$ and $i=g_c(i^*)$ and (45) is true at (w,i) .

(45) he need the football

Clearly, if what is said is evaluated relative to (w,i) , it is only true if Billy needed a football at embedding speech time (w,i) , and this is certainly not the intuitive sense of (14). If this were indeed the situation, it would be appropriate to predict Billy's utterance by uttering an instance of (46).

(46) Billy will say that he needed the football, tomorrow.

It can also be shown that with (40) as a structure for (14), if what is said is evaluated relative to (w,j) , the predicted time of speech, the truth-conditions coincide with intuition. (43) would be true at (w,j) if (44) were true at (w,j) , which would be the case if $w=g_c(w^*)$ and $j=g_c(j^*)$ and if (45) were true at (w,j) . This is the correct way to consider whether what Billy will say would be true.

And if this is so, the first approach to sentences such as (13) has been falsified, for it predicted that an embedded present tense would force a switch to the embedding speech time. On the other hand, the embedded present tense in (14) is quite consistent with the approach which we have adopted: the tense is dead, and so the value-free proposition can happily be evaluated at any interval; it so happens, of course, that the interval of interest is the time of embedded speech. From the treatments above of the examples (30) and (13), it can be concluded that (w,i) is only used as the interval for evaluation of the value-free proposition reported when the proposition itself forces it. This occurs when the value-free proposition is so specific as to evaluate to true only at (w,i) . Such a proposition is denoted by a sentence of IQ which contains a semi-parametric tense, and this in turn represents a sentence of English which harbours a live tense.

So, a truth-conditionally respectable account of indirect speech reports has now been derived. It can accommodate unbound indexicals, both inside and outside the reported speech, and it can account for anomalous sentences such as (13). The structure proposed for (13) generalises to a variety of other cases, and yet remains quite compatible with the existence of examples such as (14). The account of indirect speech reports will generalise to provide a treatment of tense and indexicals in other propositional attitude reports; what is more, it will allow us to represent the cases of *bound* indexicals such as (47).

(47) Max always said that he would be rich tomorrow

4.2 The First Type of Bound Indexical

The previous section furnished us with a useful picture of the role of unbound indexicals in indirect speech reports. It is now possible to deal with those rare cases of bound indexicals which occur in indirect speech reports, which were first noted in section 2.8 of Chapter 2.

(47) Max always said that he would be rich tomorrow

There are, it seems, two possible readings of (47). The first takes an utterance of (47) on the 18th of August 1985 to be an assertion that throughout some interval of the past, Max claimed every so often that he would be rich on the 19th of August 1985. The second reading of an utterance of (47) has no such intimate relation to the 19th of August. Rather, it is taken to say that throughout some interval of the past, Max claimed every so often that he would be rich on the day after each of those claims. The first reading takes *tomorrow* to act normally, as a parameter. The second takes *tomorrow* to act non-parametrically, and it counts as a paradigm case of what we have termed a *bound* indexical. The second reading is the preferred one; so a theory of indexicals must definitely be able to explain it. Corresponding to the two readings, we have the representations in (48) and (49) respectively.

- (48) $PAST_{(v,i)} [ALWAYS_r [Max \text{ say that } [Gv't'FUT_{(v',t')} [ON tomorrow_t (he \text{ be rich})]]]]]$
 (49) $PAST_{(v,i)} [ALWAYS_r [Max \text{ say that } [Gv't'FUT_{(v',t')} [ON tomorrow_{t'} (he \text{ be rich})]]]]]$

It can be seen that (48) and (49) differ in only one detail: in (48), "tomorrow" is rendered as a parameter, while in (49), that parameter is bound by the G-operator; it is no longer a parametric referring expression, but is now part of a more complex expression. To demonstrate the difference, it is only necessary to unpack the truth-conditions for (48), and then (49). (48) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (50) is true at (w,j) .

(50) ALWAYS_r [Max say that [Gv't'FUT_(v',t') [ON tomorrow_t (he be rich)]]]

(50) is true at (w,j) if $j=g_c(r)$ and there exists a cover P of $g_c(r)$ such that for all $p \in P$, (51) is true at (w,p).

(51) Max say that [Gv't'FUT_(v',t') [ON tomorrow_t (he be rich)]]

(51) is true at (w,p) if Max stood in the "says" relation at (w,p) to the value-free proposition named in (52).

(52) that [Gv't'FUT_(v',t') [ON tomorrow_t (he be rich)]]

As far as the truth of this reading of (47) goes, this is all that matters. But is what Max said at (w,p) true? Given the view of indirect speech reports derived in the previous section, we need to evaluate the proposition in (53) at (w,p) in order to determine whether what Max said is true.

(53) Gv't'FUT_(v',t') [ON tomorrow_t (he be rich)]

(53) is true at (w,p) if (54) is true at (w,p).

(54) FUT_(w*,p*) [ON tomorrow_t (he be rich)]

(54) is true at (w,p) if $w=g_c(w^*)$ and $p=g_c(p^*)$ and there is a q later than p such that (55) is true at (w,q).

(55) ON tomorrow_t (he be rich)

(55) is true at (w,q) if q is a subinterval of the day after the day of $g_c(t)$ and (56) is true at (w,q).

(56) he be rich

Things are very nearly, but not quite the same for the second reading of (47). (49) is true in model M at (w,i) if $w=g_c(v)$ and $i=g_c(t)$ and there is a j earlier than i such that (57) is true at (w,j).

(57) ALWAYS_r [Max say that [Gv't'FUT_(v',t') [ON tomorrow_t (he be rich)]]]

(57) is true at (w,j) if $j=g_c(r)$ and there exists a cover P of $g_c(r)$ such that for all $p \in P$, (58) is true at (w,p).

(58) Max say that $[Gv't'FUT_{(v',t')} [ON tomorrow_t, (he be rich)]]$

(58) is true at (w,p) if Max stood in the "says" relation at (w,p) to the value-free proposition named in (59).

(59) that $[Gv't'FUT_{(v',t')} [ON tomorrow_t, (he be rich)]]$

Again, as far as the truth of this reading of (47) goes, this is all that matters. What Max said is true if (60) is true at (w,p) .

(60) $Gv't'FUT_{(v',t')} [ON tomorrow_t, (he be rich)]$

(60) is true at (w,p) if (61) is true at (w,p) .

(61) $FUT_{(w^*,p^*)} [ON tomorrow_{p^*} (he be rich)]$

(61) is true at (w,p) if $w=g_c(w^*)$ and $p=g_c(p^*)$ and there is a q later than p such that (62) is true at (w,q) .

(62) $ON tomorrow_{p^*} (he be rich)$

(62) is true at (w,q) if q is a subinterval of the day after the day of $g_c(p^*)$ and (56) is true at (w,q) . The difference between (48) and (49) comes down to this: what Max is portrayed as saying in (48) is true if he is rich on the day after utterance of (47); what he is portrayed as saying in (49) is true if, for each of *his* utterances, he is rich on the day following that utterance. (63) represents a paraphrase of this reading of (47).

(63) Max always said that he would be rich the day after his speaking

We are now in a position to cash the full value of the representation of indexicals adopted in this thesis. The parametric "t" can be bound by an operator, and by allowing this, it is possible to represent non-parametric indexicals. In essence, the binding of "t" represents the fact that it derives its value from the speech time of the embedded utterance, instead of the speech time of the embedding utterance. In this case, the parametric nature of *tomorrow* is frustrated by its being embedded as part of someone else's utterances. That this should be so raises a question as to why this should happen in this case, but not in the cases considered in the previous section. This is a question to which we shall return. In this section, we have shown that quantified indirect speech reports can be dealt with in a straightforward manner. In the next section, we shall approach the gnomic utterances which first raised the notion of non-parametric occurrences of indexicals.

4.3 The Representation of Imperatives

In the previous section, the non-parametric indexicals which occur in quantified indirect speech reports were explained in terms of the binding of parameters. In the next section, essentially the same explanation will be offered for the non-parametric indexicals which occur in proverbs such as (64).

(64) Never put off until tomorrow what you can do today

In order to deal with utterances of sentences such as (64), which fall into the class of gnomic utterances, it will be necessary first to incorporate sentences in the imperative mood into the IQ framework; this is the task which will be tackled in the present section. In order to derive an adequate representation for imperative sentences, it is necessary to provide structures for both commands and commandments. It will be argued that while Richards is correct in his claim that imperatives should be represented as tenseless sentences, expressing value-free propositions, he errs in asserting that they contain no semantic tense whatsoever. If a deparametrized tense is supplied, however, an apparent conflict is generated between the representation of commands and the representation of indirect speech reports derived in section 1. The problem will be investigated, and a solution offered. It will then be possible to represent both commands and commandments; together with the representation of conditional sentences proposed in section 4, this will allow a representation for (64).

Commands, it will be recalled, require specific action from a specific individual; commandments are general injunctions requiring actions of a certain type from all individuals in a larger region of space-time. Richards argues that there is something in common in the following sentences:

- (65) Max exercise regularly
- (66) Max exercises regularly
- (67) Max, exercise regularly!

What they have in common is the value-free proposition they express. Both (66) and (67) have the value-free proposition expressed by (65) within them. The difference between (66) and (67) is that the present tense and indicative mood in (66) are created by applying the present tense operator to the value-free proposition; (67) has no tense in its form, and therefore an utterance of it cannot be taken to assert that (65) is true at the time of speech. Rather, its imperative mood is a "pure speech act device", which is not mirrored in the semantic structure assigned to (67). (67) will just contain the same value-free proposition as (65); its difference lies in the fact that an utterance of it is taken to command (65) with

respect to the future.

This account has considerable appeal, but we will argue that it can't be accepted in its present form. The reason lies, yet again, with indexicals. Take a command like (68); according to Richards, and supplying a subject, it will be assigned the representation (69).

- (68) Go to London tomorrow!
(69) ON tomorrow_t (you go to London)

In the case of commands, we cannot take IQ representations to portray the truth conditions of the English clause; rather, they must be taken to portray the satisfaction conditions of the clause. That is to say, following Dummett: we may take the representations of clauses used to issue commands on a par with the representations of sentences used assertorically, so long as we recognise that the former clauses specify what would have to be the case (if the command were obeyed and thereby satisfied), rather than what is in fact the case ²³. So, in the case of (69), we don't unpack the truth conditions in order to find out whether or not an utterance of (69) was true at speech time; rather, we unpack the conditions in order to find out what would have to be the case to make (69) true relative to speech time.

Now, if we try to make the sentence (69) true at speech time, the unacceptable result is that our current speech time is a subinterval of the day after the day upon which we speak. There are two responses that can be made to this problem. First, accepting that the value-free proposition (69) cannot be made true at speech time, it might be pointed out that it is possible to make (69) true at a time later than the time of utterance. That is, if the command is to be made true at all, it is only with respect to some future time. This proposal has a certain intuitive appeal, and seems to be compatible with what Richards says about imperatives. The second response also accepts that (69) cannot be made true at speech time; instead of resorting to evaluating (68) at other times, however, it is proposed that the expression of the value-free proposition must be elaborated in order to achieve the correct truth-conditions. (69) is replaced by (70).

- (70) Gv't'FUT_(v',t') [ON tomorrow_t (you go to London)]

It can easily be shown that (70) is true at (w,i) if (71) is true at (w,i).

²³ Cf Dummett "The sense of a statement is determined by knowing in what circumstances it is true and in what false. Likewise the sense of a command is determined by knowing what constitutes obedience to it and what disobedience" [Dummett 1959:8] or "[W]e know the individual content of an imperative sentence by knowing in what circumstances the command it conveys will have been obeyed" [Dummett 1977:449]. Page references are to the articles as reprinted in Dummett (1978).

(71) $FUT_{(w*,i*)}$ [ON tomorrow_t (you go to London)]

(71) is true at (w,i) if $w=g_c(w*)$ and $i=g_c(i*)$ and there is a j later than i such that (69) is true at (w,j) . (69) is true at (w,j) if j is a subinterval of the day after the day of $g_c(t)$ and (72) is true at (w,j) .

(72) you go to London

The essential difference between the two proposals lies in the fact that the first proposal solves the problem by elaborating the procedure which tries to make the value-free proposition true, whereas the second proposal elaborates the semantic structure of the sentences used to issue commands. It should be noted that, while this option obviously diverges from Richards' own approach, it does not claim that (70) represents a completely different value-free proposition from (69); rather, it claims that (69) and (70) denote propositions which contain the very same proposition, but that (69)'s proposition composes part of (70)'s.

In order to test these proposals, it is possible to examine their performance in commandments. An informal characterisation of the commandment has already been given; formally, and in the general case, we shall take a commandment to be formed from a command by the application of a temporal quantifier; if an indexical occurs within its scope, that indexical will be rendered in its deparametrized form. Take, for example, the commandment in (73), which is rather simpler than (64).

(73) Always put off everything until tomorrow

We must assume an intuitive analysis of *until*, represented as "UNTIL d ", where d is a date or indexical. It can be shown that the quantifier $ALWAYS_r$ has wider scope than G . This being so, the representations which Proposals 1 and 2 assign to (73) are those in (74) and (75) respectively.

(74) $(x) ALWAYS_r [Gt' [UNTIL tomorrow_t, (you put off x)]]$

(75) $(x) ALWAYS_r [Gv't'FUT_{(v',t')} [UNTIL tomorrow_t, (you put off x)]]$

Proposal 1

(74) is true at (w,i) if, for all b in the model M , (76) is true at (w,i)

(76) $ALWAYS_r [Gt' [UNTIL tomorrow_t, (you put off b)]]$

(76) is true at (w,i) if $i=g_c(r)$ and there is a cover P of $g_c(r)$ such that, for all $p \in P$, (77) is true at (w,p) .

(77) Gt' [UNTIL tomorrow_{t'} (you put off b)]

(77) is true at (w,p) if (78) is true at (w,p).

(78) UNTIL tomorrow_{p*} (you put off b)

(78) is true at (w,p) if p is a subinterval of the day after the day of $g_c(p^*)$ and (79) is true before p and false at p.

(79) you put off b

It should be noted that (78) cannot be true at (w,p); if it were, p would have to be a subinterval of the day after p. In the face of this inconsistency, a supporter of the first proposal would have to claim that while it is not possible to make (78) true at any $p \in P$, there will be, for every p in P, a q later than p such that (78) is true at q. But this response won't wash, for the following reasons. If (78) cannot be made true at (w,p), but can only be made true at (w,q), then (77) cannot be made true at (w,p). This being so, there is only one way to make (74) true at (w,i), and that is to try to make (77) true at (w,q). Unfortunately, this cannot be done; and even if it could, it would not be enough to make (74) true. (77) cannot be made true at (w,q) for the following reason: if (77) could be made true at (w,q), then it would follow that (80) was true at (w,q).

(80) UNTIL tomorrow_{q*} (you put off b)

But just as (78) cannot be true at (w,p), (80) cannot be true at (w,q). (80) could perhaps be made true at (w,r), where r is later than q, but it should be clear that this is simply another step down a path of infinite regress, and this strategy will never derive any coherent truth-conditions. Suppose however, for the sake of argument, that it is possible to make (77) true at (w,q). It can be shown that even this move will not be sufficient to make (74) true at (w,i). Assume that (77) is made true at (w,q). For almost all p in P, (77) will actually be true at some (w,p) after all, since q_n will fall in p_{n+1} . For the first p in P, however, (77) will not be true. Thus there will be no cover P such that (77) is true for *all* $p \in P$. So (76) cannot be true at (w,i). And if (76) cannot be made true at (w,i), nor can (74). It should be clear that it would do no good whatsoever to try to make (74) true at some interval other than speech time, for the arguments can be re-established for any interval at all.

Proposal 2

(75) (x) ALWAYS_r [Gv't'FUT_(v',t') [UNTIL tomorrow_{t'} (you put off x)]]

(75) is true at (w,i) if, for all b in the model M, (81) is true at (w,i)

(81) ALWAYS_r [Gv't'FUT_(v',t') [UNTIL tomorrow_{t'} (you put off b)]]

(81) is true at (w,i) if $i = g_c(r)$ and there is a cover P of $g_c(r)$ such that, for all $p \in P$, (82) is true at (w,p).

(82) Gv't'FUT_(v',t') [UNTIL tomorrow_{t'} (you put off b)]

(82) is true at (w,p) if (83) is true at (w,p).

(83) FUT_(w*,p*) [UNTIL tomorrow_{p*} (you put off b)]

(83) is true at (w,p) if $w = g_c(w^*)$ and $p = g_c(p^*)$ and there is a q later than p such that (84) is true at (w,q).

(84) UNTIL tomorrow_{p*} (you put off b)

(84) is true at (w,q) if q is a subinterval of the day after the day of $g_c(p^*)$ and (79) is true before q and false at q. Under Proposal 2, the truth-conditions which Proposal 1 struggled to produce are automatic. From the foregoing, it should be clear that the elaboration of the truth-checking procedure which was suggested for dealing with commands cannot be generalised to capture commandments. By contrast, the very same alteration that was effected in the representation of commands will suffice to generate the right truth-conditions for commandments.

The conclusion of this argument is that if commands and commandments are to be treated in the same way with respect to tense, then only the more complex representation containing deparametrized tense will prove adequate. The price for maintaining the other alternative would be that commands and commandments would differ fundamentally with regard to tense. So, we will treat them similarly, and use the elaborated representation in both cases. To the extent that a command is a "pure speech act device", it is so because it is an utterance of a sentence expressing a value-free proposition, and such a proposition does not, of itself, have a truth value. On this account, commands and commandments are what they are because an utterance of, say, a command does not assert that the value-free proposition is true; it merely presents the value-free proposition in a particular form that leaves the hearer of the utterance the work of finding out what would have to be the case if the utterance were in fact true. Richards was right in claiming that imperative sentences are

tenseless, but he was wrong in claiming that they have no tense operator in their representation. The fact of the matter is that the tense operator is deparametrized.

We have now derived representations of both indirect speech reports and imperatives. It might be argued that the representation of imperatives derived in this section makes them just the sort of thing that appears in the complement clause of an indirect speech report, and that since they do not do so in natural language, the representation must be wrong. This argument will first be presented in more detail, before an explanation is tendered.

An imperative has the form " $Gv't'FUT_{(v',t')} (A)$ " where A is a context-free sentence denoting a value-free proposition. There are indirect speech reports whose complement clause has an identical structure; for instance, (85) has the representation (86).

- (85) Harold said that Edward would be Prime Minister
 (86) $PAST_{(v,t)} [Harold \text{ say that } [Gv't'FUT_{(v',t')} (Edward \text{ be Prime Minister})]]$

Since both imperatives and the complement clauses express value-free propositions, and do so with deparametrized tenses in their representations, it would seem as though imperatives should be able simply to "slot into" indirect speech reports. Suppose that Max commands Janet to leave by uttering the imperative sentence (87). If (88) is the representation of (87), and (89) the representation of an indirect speech report which contains (88) as a subformula, then (so the argument goes), (89) should be a representation of the natural language sentence (90).

- (87) Janet, leave!
 (88) $Gv't'FUT_{(v',t')} (Janet \text{ leave})$
 (89) $PAST_{(v,t)} [Max \text{ say that } [Gv't'FUT_{(v',t')} (Janet \text{ leave})]]$
 (90) Max said that Janet leave!

The question is: what is the difference between (88) standing alone, and embedded in (89)? The essence of the answer is that it is reasonable to represent imperative sentences and the complement clauses in the same way; yet (89) is not the right way to represent a report of the utterance of (87). In more detail, it is correct to represent imperatives with a deparametrized future tense; it is also correct to represent the complement clauses of some indirect speech reports with formulae which contain a deparametrized future tense. However, those speech reports which do contain such formulae happen to report assertions about the future; that is, these speech reports are reports of predictions. It would be inappropriate to report commands (that is, utterances of imperatives) as if they were predictions, and for this reason, it is necessary to report commands by stating that the reported speaker stood in a rather different relation to the value-free proposition which is

represented by the formula containing the deparametrized future tense. For example, (89) is a representation of the speech report (91), which reports an utterance by Max of the sentence (92).

- (91) Max said that Janet would leave
- (92) Janet will leave

In this case, Max predicted that Janet would leave, and (89) is the correct representation of a report of this prediction. Unless Max is in the metaphysically unlikely position of being an entity whose every command is carried out, it would be inappropriate to report his command (87) by uttering an instance of (91). For this reason, (89) would be the wrong representation for a report of his command. (91) is a bad way of reporting (87) because it asserts that Max stood in the relation of saying to the value-free proposition represented in (88), whereas he actually stood in the relation of commanding his hearer to make that proposition true. A neutral way of reporting Max's command is to utter an instance of (93), which is represented by (94).

- (93) Max demanded that Janet leave
- (94) $PAST_{(v,t)}$ [Max demand that $[Gv't'FUT_{(v',t')} (Janet \text{ leave})]]$

The difference between (88) on its own and (88) embedded in (94) can be described in terms of the attempt to evaluate the value-free proposition it represents. In both cases, we must find out what must obtain if what Max said is to be made true. In the first case, we would find out what must be done in order to make the value-free proposition true: Janet must leave at some time after his utterance. In the second case, we would find out whether what Max said is true by determining whether or not Janet left at a time later than his utterance. And finally, if (88) is embedded in (94), evaluating the value-free proposition helps to determine what must obtain if what Max demanded is to be made true.

So, imperatives can indeed slot into indirect speech reports, but they must slot into the right reports; that is, demand reports, which do not contain tense in English. Speech reports proper do contain embedded tenses in English, but are not the appropriate vehicle for reporting commands. And the fact that complement clauses in certain indirect speech reports contain the same type of subformula as imperatives is both explicable and acceptable, given that the subformula represents a value-free proposition. In this discussion of the proper representation of the sentences used in commands, we have necessarily touched on the representation of commandments, and specified that they are quantified commands. In the next section, the representation of more complex commandments will be considered in slightly more detail.

4.4 The Representation of Conditionals

In section 4.3, a representation of commands and commandments was developed. In showing that imperatives contain an implicit deparametrized future tense in their form, a commandment containing a bound indexical was treated. The binding of the indexical is possible because the temporal quantifier opens up the possibility of the indexical expression being evaluated relative to elements in the domain of the temporal quantifier, rather than relative to speech time. To represent the example (64), however, it is necessary to consider the representation of conditionals in the IQ framework.

(64) Never put off until tomorrow what you can do today

Conditionals must be given an representation for the simple reason that (64) is a commandment which is conditional in form. (95) is a conditional command:

(95) If you got wet yesterday, then take your boots today

It will be possible to treat both (64) and (95) once an adequate representation of the conditional form has been arrived at. This will be established in three steps. First, then, there is a question concerning the status of conditionals with respect to assertion. When one utters such conditionals as (96) and (97), does one assert either the consequent, or the antecedent?

(96) If the car is ready this morning, we will go to Perth tomorrow.

(97) If Kennedy had not been assassinated, a world war would have occurred.

It does not seem as though an assertion of (96) involves an assertion of either (98) or (99); and an assertion of (97) obviously does not involve an assertion of the antecedent (100), let alone the consequent (101).

(98) The car is ready this morning

(99) We will go to Perth tomorrow

(100) Kennedy had not been assassinated

(101) A world war would have occurred

Asserting the truth of a conditional does not involve asserting the truth of either its antecedent or its consequent. We must reflect this fact in the structures which are assigned to represent conditionals. The essential mechanism of assertion in IQ is the tense. Without a tense, a sentence is merely context-free, expressing a value-free proposition. Nothing is said about the truth or falsity of that sentence relative to the time of speech; only a tense can make a proposition value-specific; only a tense allows a speaker to say something which is true or false. Since we do not want to portray the antecedent or consequent of a

conditional as invoking the mechanism of assertion, it will be necessary to leave their sub-formulae in the representation of the conditional semantically untensed.

There are two ways a formula may be untensed. First, it may have no tense operator in its structure whatsoever; secondly, it may have tense operators in its structure, but they must be deparametrized. In the latter case, the formula will still be context-free, and will still represent a value-free proposition. It can easily be shown that conditionals such as (96) must contain some means of fixing the interval at which the consequent is to be evaluated in such a way as to allow that interval to fall within the interval determined by the indexical *tomorrow*. Unless the consequent has a future tense in it, incoherency will result. Since this is so (we could show it to be the case only when all the resources are in place), the second kind of tenselessness must be chosen for the clauses of conditionals. So, conditionals' clauses will each contain a deparametrized tense. That deparametrized tenses should sometimes be morphologically realised in just the same way as "real" tenses is perhaps a little surprising, but it clearly occurs elsewhere in English. The deparametrized past tense in (102) appears in the English sentence (103) as a syntactic past tense.

- (102) $PRES_{(v,t)}$ [Mark say that $[Gv't'PAST_{(v',t')}]$ (he write the letter)]]
 (103) Mark says that he wrote the letter

Secondly, while neither of the clauses of a conditional is asserted, the conditional itself *is* asserted. If it were not, there would be no point to utterances of conditionals. If the sentence itself is asserted, then it must have a context-sensitive sentence as its representation. Since neither the antecedent nor the consequent supplies this context-sensitivity, the tense must scope over the whole of the conditional sentence. With the three tenses of the theory, it is possible to make assertions to the effect that a given conditionals is, was or will be the case.

Given the first two points, the third follows immediately. Where A and B are context-free sentences, and Q_i ranges over {PRES,PAST,FUT}, the form of conditional sentences will be that in (104).

- (104) $Q_{1(v,t)}$ [$Gv't'$ [*If* $Q_{2(v',t')}$ (A) *Then* $Q_{3(v',t')}$ (B)]]

Since the main tense will interact with the tense of each of the subordinate clauses, there will be a sense in which the tense of each clause is not independent of the other. The link between them can be factored out as the main tense of the conditional. This fact falls out naturally from the constraints on embedding tenses; and at the same time, it elegantly explains the intuition, which some people have felt, that the tenses of the antecedent and consequent are in some way connected. In the terms of IQ, they are bound by the same

operator, and are in the scope of the same tense operator. To complete this brief account of conditionals, it only remains to supply the semantic clause for "If A, then B". This clause is, of course, only a "toy" one, in that it merely represents a material conditional. It would not be adequate for counterfactual cases such as (97), but it will suffice for the moment.

- (105) *If (A), Then (B)* is true in model M at (w,i) if either A is false at (w,i) or B is true at (w,i); it is false at (w,i) if A is true at (w,i) and B is false at (w,i); and otherwise it is undefined.

Thus, we have a representation of conditionals. Conditional commands such as (95) are conditional sentences which have (a) no main tense and (b) a deparametrized future tense scoping over the consequent clause²⁴. Conditional commandments such as (64) are conditional sentences which have (a) no main tense, (b) a deparametrized future scoping over the consequent clause and (c) a temporal quantifier scoping over the whole conditional, thereby allowing it to become apparent that indexicals are bound by G. Put simply, conditional commands stand in precisely the same relation to declarative conditionals as commands stand to declarative sentences. Meanwhile, conditional commandments stand in the same relation to conditional commands as commandments to commands.

4.5 The Second Type of Bound Indexical

Section 4.3 contained an example of a bound indexical occurring in a commandment. With the discussion of conditionals in section 4.4 in mind, it is possible now to represent bound indexicals in conditional commandments as well; an added bonus is the possibility of representing unbound indexicals in conditional commands. Taking the second of these first, (106) is the representation of (95).

- (95) If you got wet yesterday, then take your boots today
 (106) $Gv't' [If [PAST_{(v',t')} [ON yesterday_t (you\ get\ wet)]] Then [FUT_{(v',t')} [ON today_t (you\ take\ your\ boots)]]]$

(106) is a command. How can it be made true at (w,i)? It is true at (w,i) if (107) is true at (w,i).

²⁴ According to Dummett (1973:340-44), there will be no substantive difference between commanding the truth of a material conditional and giving a conditional command, that need only be carried out if the antecedent is true. We could replace (b) with (b'): a deparametrized future tense scoping over the whole conditional. We could thereby make our use of "conditional command" agree with Dummett's "commanding a conditional", the more basic use. Both (95) and (64) would receive slightly different truth conditions.

- (107) *If* [$PAST_{(w^*,i^*)}$ [ON yesterday_t (you get wet)]] *Then* [$FUT_{(w^*,i^*)}$ [ON today_t (you take your boots)]]

(107) is a conditional. It is true at (w,i) if either (108) is false at (w,i) or (109) is true at (w,i). Given that the issue of the command makes the action to be taken (the consequent) conditional on the truth of the antecedent, it is only necessary to calculate the truth value of (109) when (108) is true at (w,i).

- (108) $PAST_{(w^*,i^*)}$ [ON yesterday_t (you get wet)]
 (109) $FUT_{(w^*,i^*)}$ [ON today_t (you take your boots)]

(108) is true at (w,i) if $w=g_c(w^*)$ and $i=g_c(i^*)$ and there is a j earlier than i such that (110) is true at (w,j).

- (110) ON yesterday_t (you get wet)

(110) is true at (w,j) if j is a subinterval of the day before the day of $g_c(t)$ and (111) is true at (w,j).

- (111) you get wet

Now, to make (107) true, given the truth of (108), we must make (109) true at (w,i). (109) is true at (w,i) if $w=g_c(w^*)$ and $i=g_c(i^*)$ and there is a k later than i such that (112) is true at (w,k).

- (112) ON today_t (you take your boots)

(112) is true at (w,k) if k is a subinterval of the day of $g_c(t)$ and (113) is true at (w,k).

- (113) you take your boots

So, evaluating the value-free proposition which the command (95) expresses entails finding out what must be true for the command to be made true, given that the antecedent is true.

Thus, unbound indexicals fit easily into the representation of commands, both conditional and unconditional. We have already seen that bound indexicals fit into unconditional commandments. It only remains to show that they can also be represented in conditional commandments. To this end, let us take (114) as the representation of our old friend (64).

- (64) Never put off until tomorrow what you can do today
 (114) (x) $NEVER_t$ [$Gv't'$ [*If* [$PRES_{(v',t')}$ [ON today_{t'} (you can do x)]] *Then* [$FUT_{(v',t')}$ [UNTIL tomorrow_{t'} (you put off x)]]]]]

(114) is true at (w,i) if, for all b in the model, (115) is true at (w,i).

- (115) NEVER_t [Gv't' [If [PRES_(w',t') [ON today_{t'} (you can do b)]] Then [FUT_(v',t') [UNTIL tomorrow_{t'} (you put off b)]]]]]

(115) is true at (w,i) if $i = g_c(r)$ and there is no cover P such that, for some $p \in P$, (116) is true at (w,p).

- (116) Gv't' [If [PRES_(v',t') [ON today_{t'} (you can do b)]] Then [FUT_(v',t') [UNTIL tomorrow_{t'} (you put off b)]]]

(116) expresses a value-free proposition. It is true at (w,p) if (117) is true at (w,p).

- (117) If [PRES_(w*,p*) [ON today_{p*} (you can do b)]] Then [FUT_(w*,p*) [UNTIL tomorrow_{p*} (you put off b)]]]

(117) is a conditional. It is true at (w,p) if either (118) is false at (w,p) or (119) is true at (w,p). Since the commandment makes the action to be avoided (the consequent) conditional on the truth of the antecedent, it is only necessary to calculate the truth value of (119) when (118) evaluates to true at (w,p).

- (118) PRES_(w*,p*) [ON today_{p*} (you can do b)]
 (119) FUT_(w*,p*) [UNTIL tomorrow_{p*} (you put off b)]

(118) is true at (w,p) if $w = g_c(w^*)$ and $p = g_c(p^*)$ and (120) is true at (w,p).

- (120) ON today_{p*} (you can do b)

(120) is true at (w,p) if p is a subinterval of the day of $g_c(p^*)$ and (121) is true at (w,p).

- (121) you can do b

To make (119) true at (w,p), given the truth of (118), it is necessary to make (119) true at (w,p). This is the case if $w = g_c(w^*)$ and $p = g_c(p^*)$ and there is a q later than p such that (122) is true at (w,q).

- (122) UNTIL tomorrow_{p*} (you put off b)

(122) is true at (w,q) if q is a subinterval of the day after the day of $g_c(p^*)$ and (123) is true before q, and false at q.

- (123) you put off b

If the conditional commandment (114) is the representation for (64), then it tells us to never make it the case that, whatever the day is, we put off until the day after anything we could do on the day itself. The paraphrase is clumsy, but it is close to the intuitive paraphrase given in section 9 of chapter 2, and it is correct.

4.6 Conclusions

This chapter has shown how to deal with all the instances of non-parametric indexicals in single sentences, except for those occurring in direct speech reports. It should now be clear when the binding of indexicals may occur. When the linguistic context is of a certain sort, intervals other than speech time are made available, relative to which indexicals can be evaluated.

In the single-sentence cases we have been examining, the binding of indexicals only occurs in the presence of a temporal quantifier. The quantifier does not itself bind the indexical expression. Rather, it opens up the possibility of binding by making available subintervals distinct from the time of speech, relative to which the indexical can be evaluated. It is in fact *G* which binds the indexical. In the discourse-based examples, which were mentioned briefly in section 6.4 of Chapter 3, *G*'s effect became apparent for much the same reason. Narratives make available intervals as alternatives to speech time; in this way binding is made possible. In both cases, the availability to the utterer of the "alternative" intervals allow the presence of *G* to be felt; if there were no alternative to speech time, the *G*-operator would make no effective difference.

So, in single-sentence cases, bound indexicals normally occur when a temporal quantifier is present. Recalling P-Principles 1 and 2, we can now make clear which contexts fall under which Principle:

P-Principle	1:	Unbound indexicals act parametrically.
P-Principle	2:	Bound indexicals act non-parametrically.

In this chapter, we have considered two cases of non-parametric indexicals; both involved temporal quantifiers. It should be clear from the brief that discussion in Chapter 3 concerning the quantifier *SOMETIME_r* that the one outstanding unquoted bound indexical from Chapter 2 (the *don't* version of (64)) can also be regarded as involving temporal quantification. In these cases, temporal quantifiers offer intervals distinct from speech time relative to which the indexical may be considered. The case of the quoted bound indexicals, discussed in section 8 of Chapter 2, is only slightly different. In the absence of a temporal quantifier which can supply alternatives to speech time, it seems as though we can use an explicit signal in natural language to indicate that it is not the speech time of the whole utterance that is of interest. Quotation marks seem to fill this very role. When a clause occurs within quotation marks, the indexicals should be evaluated relative to the time of the directly reported speaker.

In both the quoted and unquoted cases, the indexicals would be represented in the language of IQ as having their parameters bound out by a G. Once a temporal quantifier is introduced into the form, the need for quotation marking disappears. As a result, we can say that all indexicals fall under P-Principle 1, excepting those which are bound by a G at the logical level, which therefore fall under P-Principle 2. The contexts in natural language which allow this (they do not, of course, force it) involve temporal quantification or quotation of some sort. Indirect speech reports containing indexicals have drawn our attention towards what is, was, or will be said. It is to propositions that we now turn.

Chapter 5: Propositions

In Chapters 2 to 4, we have considered in turn two types of indexicals, and then shown how it is possible to represent them in a semantic framework designed to deal with tense and temporal quantifiers. The IQ framework is a novel one in various respects, not least in the semantic entities corresponding to sentences of the language of IQ. In the course of the research pursued in the previous chapters, various decisions have been made that elaborate and articulate the propositions of IQ. In this chapter, we shall tackle the second specific task of the thesis; we must show what propositions are required by the semantics for temporal indexicals which we have adopted.

To this end, we'll first consider the far-reaching effects of the decisions taken in the earlier chapters, and sketch the new picture of propositions that emerges after indexicals have been incorporated into the theory. We can then go on to show how the propositions we end up with are related to Kaplan's contents, to Frege's semantic entities, and how they allow us to articulate some of the concepts that Russell was originally concerned with. The later sections of the chapter will involve a considerable amount of quotation from the sources; this is both necessary and illuminating, given the basic aim of properly characterising the fundamental entities of our semantic theory.

5.1 The Nature of IQ Propositions

We have already noted that Richards' original (1986) presentation of the IQ framework invokes two types of proposition, one type being closely allied to the truth-value of utterances, the other corresponding to the content of utterances. The former are known as value-specific propositions, the latter as value-free propositions. In what follows, we shall say that the value-specific proposition associated with an utterance of a tensed sentence is the proposition *denoted* by that utterance; and the value-free proposition associated with the utterance is the proposition *expressed* by the utterance. An utterance of an untensed sentence does not make an assertion, and the sentence will only have a value-free proposition associated with it; we may say that this is the proposition denoted by the sentence. This terminology is employed with the explicit intention of echoing Frege's distinction between the truth-value *denoted* by a sentence, and the thought *expressed* by it.

In this section, we shall explore the value-free terrain; in so doing, we shall uncover

several distinct types of proposition. In particular, it will be suggested that the incorporation of parametric indexicals into IQ forces us to take seriously the notion of temporally specific value-free propositions. If this is indeed the case, it will be necessary to show that their introduction does not cause the distinction between value-freedom and value-specificity to break down. Richards himself regards these notions as mere “terms of art”; in defending the distinction between them, however, we shall demonstrate that the concepts have determinate technical content.

5.1.1 Value-Free Propositions

The identity conditions for value-specific propositions are obvious: two value-specific propositions are one and the same if they are the proposition which evaluates to true for the same world-interval pair or if they are the proposition which evaluates to false for all world-interval pairs. The identity conditions for value-free propositions, which have been taken to convey information content, are less obvious. There are, as we have seen, two ways in which a natural language sentence can be thought of as tenseless; both ways represent the sentence with a context-free sentence in the language of IQ; both ways take that context-free sentence to denote a value-free proposition. The first way has no tense operators, parametric or otherwise, in the representation; the second way has only deparametrized tense operators. Since we allow deparametrized tense operators to appear in a sentence of IQ which must, by definition, denote a value-free proposition, the identity conditions for value-free propositions turn out to be rather subtle.

Suppose that the following situation obtains in the actual world w . It rained at i_0 . It rained at i_2 . In between these two meteorological events, Mary and Robert utter two sentences simultaneously. Mary utters (1) at i_1 ; Robert utters (2) at the same time.

- (1) It rained
- (2) It will rain
- (3) $PAST_{(v,t)}(It\ rain)$
- (4) $FUT_{(v,t)}(It\ rain)$

Both those utterances are true. Given that the contextual function g_c assigns w to v and i_1 to t in both (3) and (4), we can say that if (3) and (4) represent the respective utterances, it must be the case that (3) and (4) denote the same value-specific proposition. Specifically, the proposition they denote is the intension which takes only the world-time pair (w, i_1) to true. Both utterances involve the value-free proposition denoted by the context-free sentence (5).

(5) It rain

In Chapter 4, we identified what was said with the value-free proposition expressed by an utterance. It might therefore be thought that the two distinct utterances of (1) and (2) both say the same thing, since they both express the same value-free proposition. But this cannot be right, for intuition suggests that the utterances say different things: Mary asserts that it rained before she spoke; Robert asserts that it will rain after his speaking. Further evidence that Mary and Robert said different things is supplied by the means available for reporting what they said. If Kate utters the sentence (6) at (w, i_2) , she is reporting what Mary said.

(6) Mary said that it rained

The representation of this sentence ²⁵ is given in (7):

(7) $PAST_{(v,i)} [Mary \text{ say that } [Gv't'PAST_{(v',t')} (It \text{ rain})]]$

Kate cannot accurately report what Robert said by uttering (8), for it portrays Robert as standing in the same relation to the same value-free proposition as Mary. And that value-free proposition is not what Robert said.

(8) Robert said that it rained

If Kate wants to report what Robert really said, she would have to utter the sentence (9), which is represented in (10).

(9) Robert said that it would rain

(10) $PAST_{(v,i)} [Robert \text{ say that } [Gv't'FUT_{(v',t')} (It \text{ rain})]]$

The linguistic resources available force Kate to report Mary and Robert's utterances in different ways. Those ways reflect the fact that the two simultaneous speakers stand in the relation of saying to two *different* value-free propositions. Thus it can be seen that Mary and Robert expressed the distinct value-free propositions named in (11) and (12).

(11) that $[Gv't'PAST_{(v',t')} (It \text{ rain})]$

(12) that $[Gv't'FUT_{(v',t')} (It \text{ rain})]$

The value-free propositions denoted by these names are distinct functions from indices to truth-values. It is simple to show, for some model, that not only do (11) and (12) denote different functions, but that neither function is the same as the function denoted by (5). From this it follows that the three functions are non-equivalent.

²⁵ Note that by omitting to mention what g_c assigns to the parameters, we return to speaking in terms of the representation of sentences rather than the representation of particular utterances. This mode of speech makes no substantive difference to the argument, and makes things slightly simpler.

This all goes to show that the value-free proposition expressed by a tensed utterance is denoted by a context-free sentence of IQ which contains the original tense in deparametrized form. Painting the picture in the Russellian manner, we might say that these propositions involve individuals and relations between those individuals; it is now clear that they also involve the temporal relation between the speaker and those individuals and relations. Put simply, a value-free proposition can incorporate the information that it is before or after something else. To paraphrase Richards, Mary and Robert's utterances at (w, i_1) denote the same intension; what's more, they do so with respect to the same intension, which is denoted by (5); that intension cannot, however, account for the difference in information content between the utterances of (1) and (2).

- (1) It rained
- (2) It will rain
- (5) It rain

That is: Mary and Robert's utterances (1) and (2) denote the same value-specific proposition; and in both cases, that value-specific proposition is a function of the same value-free proposition (which is denoted by (5)). So: we haven't yet isolated the factor that gives the utterances different contents.

What can account for the difference in content is the temporal relation each speaker had towards the same intension. Let us call this temporal relation the *direction* of the proposition. What is said is a combination of the bare intension and the direction of the intension. What is said is itself an intension, namely, the value-free proposition expressed by the utterance. It is this *directed* value-free proposition which is at issue when indirect speech reports and propositional attitudes are under discussion.

So, there is more than one type of value-free proposition available in the semantics of IQ. There are the bare propositions denoted by context-free sentences which do not even contain deparametrized tense operators; and there are the directed propositions denoted by context-free sentences which do contain deparametrized tense operators. It should perhaps be noted that the operator PRES is an exception, in that the proposition denoted by (13) is the same as the proposition denoted by (14), where A is a context-free sentence.

- (13) $Gv't'PRES_{(v',t')}(A)$
- (14) A

This corresponds to the fact that the present tense operator introduces no new perspective on the individuals involved in a proposition. Figuratively, we need travel in neither direction (earlier nor later) to reach the bare intension. None of the value-free propositions

discussed so far involve indexicals, and it was shown in Chapter 4 that indexicals are an important factor in determining what was said. It is to indexicals that we now turn.

5.1.2 Temporal Specificity

Indirect speech reports require us to invoke value-free propositions; indexicals commonly appear within such reports. In this section, we outline the denotational effects of the representation of unbound indexicals discussed in section 1 of Chapter 4. In the next section, we'll examine the serious implications which these effects have for the distinction between value-free and value-specific propositions.

- (15) Nick said that he would dine in Alicante yesterday

Sentences such as (15) are ambiguous. (15) may be read in either of two ways. Under the first reading (represented in (16)), the temporal adverb *yesterday* locates the time of reported speech. Under the second reading (represented in (17)), the indexical locates the time of the activity rather than the time of speech.

- (16) $PAST_{(v,t)}$ [ON yesterday_t [Nick say that [Gv't'FUT_(v',t') (he dine in Alicante)]]]]
 (17) $PAST_{(v,t)}$ [Nick say that [Gv't'FUT_(v',t') [ON yesterday_t (he dine in Alicante)]]]]

It is the second of these two readings that is of interest to us here. The value-free proposition which is to be identified with what Nick said is denoted by the context-free sentence in (18).

- (18) Gv't'FUT_(v',t') [ON yesterday_t (he dine in Alicante)]
 (19) Gv't'FUT_(v',t') (he dine in Alicante)

This proposition is more specific than the proposition denoted by (19). Both propositions, it will be noted, are directed. The deparametrized future tense models the fact that Nick's putative assertion was about a time later than his time of speech. But (18) embodies more information than (19). For a particular utterance of (15) on the 2nd of October 1985, it is asserted that, at a time before the time of speech, Nick stood in the "says" relation to the value-free proposition denoted by (18). Now, if what Nick said is true, then it must be the case that at a time later than his time of speech, but falling on the 1st of October, he dined in Alicante. If he had stood in the "says" relation to the value-free proposition denoted by (19), then for his statement to be true, it would suffice if he merely dined in Alicante at some time later than his time of speech. In this case, there would be no other condition on

the actual time of his dining; certainly it need not be on the 1st of October. So, the value-free proposition which is denoted by the sentence with the parametric indexical has more information content in it, since (in Russellian terms) it is more specific as to the time at which relations hold between individuals. Taking intensions as functions, the proposition is more specific in that it can take fewer world-time pairs to true.

To take another example, the value-free proposition expressed by an utterance of (20) is more specific than the value-free proposition expressed by an utterance (21). This is so, even if the utterances are simultaneous and true.

- (20) John will be ready tomorrow
- (21) John will be ready

If the utterances take place at 3pm on the 3rd of October, then the value-free propositions expressed by (20) and (21) are denoted by the context-free sentences (22) and (23) respectively.

- (22) $Gv't'FUT_{(v',t')} [ON\ tomorrow_t (John\ be\ ready)]$
- (23) $Gv't'FUT_{(v',t')} (John\ be\ ready)$

The time of utterance doesn't figure in the form of the tense in either sentence for the very good reason that the tense is no longer deictic; it appears in the sentences in order to indicate the relative temporal positions of their speakers and the individual and the property featuring in the propositions denoted. If $g_c(t)$ is 3pm on the 3rd of October, and we abstract from the direction signalled by the deparametrized tense, the propositions in question amount to (24) and (25) respectively.

- (24) John be ready on 4/10/85
- (25) John be ready

We shall call propositions such as (24) which embody temporal restrictions on the relations holding among individuals *temporally specific* value-free propositions; and contrast them with *temporally neutral* value-free propositions such as (25). So far, we've concentrated on the indexicals which make value-free propositions temporally specific; but other temporal adverbs do just the same thing. Dates and other expressions which refer to times will create temporally specific propositions. The difference between dates and indexicals disappears within the proposition; however, the difference is manifest in the means available for saying the same thing twice. To say the same thing twice, one must express the same value-free proposition. If the original value-free proposition was directed, the new proposition must have that same direction; if the original value-free proposition was temporally specific, three possibilities are opened up. First, whether the original proposition was made

temporally specific by the use of an indexical or by the use of a date, it is possible to express the same proposition by using the date which picks out the original time. For example, the value-free proposition expressed by an utterance of the sentence (26) on the 4th of October can be expressed again by an utterance of (27) on the 5th of October.

- (26) I will meet her the day after tomorrow
- (27) I will meet her on the 6th of October

Secondly, however the original proposition was made temporally specific, it is possible to express it again by using a temporal indexical which picks out the appropriate time. For example, the proposition expressed by an utterance of (28) on the 6th of October is the same proposition as that expressed by an utterance of (29) on the 7th of October.

- (28) I will finish reading *Persuasion* tomorrow
- (29) I will finish reading *Persuasion* today

Thirdly, whether or not the original proposition was temporally specific, it is possible to express it again, at the same time invoking temporal specificity by using one of the semi-parametric tenses we discuss in section 1 of Chapter 4. A semi-parametric tense captures both the direction from the original speaker to the (bare) proposition, and makes the whole proposition specific enough to be true with respect to the reporting speaker's speech time only. This last option opens up the possibility of a speaker both reporting what was said, and "agreeing" with it at the same time. In this way, we have the beginnings of a semantic account of the way shared presuppositions seem to license the use of live tenses within embedded clauses (cf Costa (1972)).

Putting semi-parametricity aside, however, the difference between dates and indexicals can now be seen: to express the same proposition twice using indexicals, it is very often necessary to change the indexical, in order to pick out the same temporally specific proposition. By contrast, the same date can be used to express the same proposition twice. The use of either indexicals or dates gives rise to temporally specific propositions; indeed, they give rise to exactly the same type of propositions. The crucial difference is that the indexical is a means of specifying time which is dependent on the speaker's temporal location²⁶. It is for this reason that in indirect speech reports, even embedded indexicals are interpreted relative to the reporter's speech time, while the embedded tense is interpreted relative to the reported speech time. So both tense and indexicals make propositions finer-grained. The tense can actually become part of a more complex proposition, while the indexical only helps to pick out an interval, which specifies in turn an even more precise proposition. Dates deliver temporally specific propositions too, but they do so in way independent of

²⁶ In this respect, semi-parametric tense resembles indexicals rather closely.

the speaker's location; it makes no difference whether an embedded date is interpreted relative to embedding or embedded speech time.

The issue of saying or thinking the same the thing twice is explored in the field Kaplan calls *cognitive dynamics* ²⁷. The varieties of value-free proposition which we have discovered in the IQ framework offer the subtlety which would be required in an attempt to implement cognitive dynamics. For the time being, it should suffice to note that there is a range of value-free propositions: there are bare, temporally neutral propositions; there are directed temporally neutral propositions; there are bare, temporally specific propositions; and there are directed, temporally specific propositions.

5.1.3 Temporal Specificity and Value Specificity

The existence of this range may awaken doubts as to the accuracy of distinguishing value-specific propositions from certain varieties of value-free proposition. As the theory stands, the distinction is crucial; if it can be shown that the introduction of temporally specific value-free propositions undermines the distinction, then IQ is in trouble. The distinction is important for the following reason: at the moment, the only device that can give rise to a value-specific proposition is undeparametrized tense. If value-specificity could be brought in through the backdoor, the privileged role of tense with respect to assertion would dissolve, and it would be necessary to provide a new explanation for the difference between tensed and untensed sentences. Currently, tensed sentences are asserted, and thereby acquire truth-values; tenseless sentences appear in contexts where they are not asserted, and their reference is what is said, rather than a truth value.

In order to show that temporally specific value-free propositions are no threat to the status quo, we shall establish two points in turn: first, in this section, the argument purporting to prove that they are really value-specific propositions will be refuted; secondly, in the next section, an attempt to create value-specific propositions using temporally specific value-free propositions as stepping-stones will be shown to be essentially harmless. The discussion there will touch briefly upon alethic modalities.

First, then, it is possible to argue that temporally specific value-free propositions are really value-specific propositions in the following way. By definition, it must be possible for a

²⁷ Kaplan (1977) Section XVII and Note 35.1

value-free proposition to be true at indices other than the moment of utterance. If there are such things as temporally specific value-free propositions, they will be functions that evaluate to true only for one index; for this reason, they cannot be regarded as value-free. And if they are not value-free, they must be value-specific. One might support this argument by appealing to the following sort of consideration:

Where there can be no reference to the time of utterance, there can be no assertion. If there were a reference to speech time in uttering 'The earth moves' in the context 'Galileo said that the earth moves', it would express a value-specific proposition.²⁸

If there can be no assertion where there is no reference to the time of utterance, then (so the argument might go) if there is reference to speech time, which is certainly the case with sentences containing indexicals, there must be assertion. And what's more, in the argument suggested above, it is claimed that a reference to speech time creates a value-specific proposition.

This argument is invalid, and there is a simple explanation for its failure. The argument assumes that by "index", we mean "speech time". The fact of the matter is that an index is not simply a time, but a world-time pair. Having reference to speech-time in the sentence which denotes the proposition is necessary for that proposition's being value-specific, but it is not sufficient. To turn a value-free proposition into a value-specific proposition, a reference to the world of the utterance is also necessary. In propositions which are merely temporally specific, there is no such world reference; for this reason, temporally specific value-free propositions are not specific enough to be called value-specific propositions. It would therefore be wrong to say that a reference to speech time is enough to make a proposition value-specific; and the argument ignores the fact that, although they might not be true at other **temporal** indices, temporally specific value-free propositions may be true at other **world** indices. Indeed, it is these very world indices which allow us to distinguish the propositions invoked in indirect speech reports which involve temporal adverbs. So, we do not have unexpected and inconvenient value-specific propositions in the system. There is, however, a second problem facing the advocate of temporally specific value-free propositions, and it is to this problem that we now turn.

²⁸ A point similar to this was made in an earlier draft of Richards (1986); it is modified in the published version, where it appears on page 175.

5.1.4 World Specificity and Value Specificity

If such propositions are indeed legitimate, it could still be argued that by a simple addition to IQ, it would be possible to create value-specific propositions without using tense. If a temporally specific proposition is still nominally value-free, then all we need to convert it into a value-specific proposition is an operator which specifies the world in which the proposition is to be true. In other words, just as we made an ordinary proposition more specific as to the time at which its relations held amongst its individuals, it should be possible to make such a proposition more specific as to the world in which its relations hold amongst its individuals. An obvious candidate for such an operator is given in (30).

- (30) $AT\ actual_v(A)$ is true in M at (w,i) if $w=g_c(v)$ and A is true in M at (w,i) ; it is false at (w,i) if either $w \neq g_c(v)$ or A is false at (w,i) ; and otherwise it is undefined.

With this parametric world-indexical expression, it should be possible to create a value-specific proposition without using a tense. In this section, we will first outline the effects on IQ of adding such an operator to its object-language, and secondly investigate whether English contains an expression that might correspond to this operator.

Take the sentence of IQ (31). An utterance of it at an index (w,i) would denote a value-specific proposition:

- (31) $AT\ actual_v[AT\ now_t(Mick\ be\ ill)]$

Suppose that $w=g_c(v)$ and $i=g_c(t)$, and that Mick is ill at (w,i) . Then the utterance will be true at that index and no other; just like a value-specific proposition created by a tense. Thus, we might argue that if " $AT\ actual_v$ " and " $AT\ now_t$ " go together to create a value-specific proposition, then the two operators compose the internal structure of " $PRES_{(v,t)}$ ". In other words, if a couple of operators turn out to make a value-free proposition into a value-specific one, then they are a tense.

What would happen to IQ if we added the operator to the object-language? (31) is a sentence of IQ which is context-free, by definition. If we allow it to denote a value-specific proposition, then the correlation between context-freedom of sentences and value-freedom of propositions is lost. Either we bite the bullet, and allow the correlation to break down, or else we must alter the definition of context-freedom in order to make (31) context-sensitive. So: we can add " $actual_v$ " to the object-language of IQ if we wish, at a price. However, IQ is not simply an abstract logical system: its object-language is designed to serve as a representational language which reveals some of the semantic structure of

English. If this is so, we must ask the following question: does English offer any independent reason for adding a modal indexical to IQ? Or, to put it another way, is there a separate natural language analogue for "actual_v", which requires the operator as its formal representation?

The prime candidate for the English analogue of "AT actual_v" is the expression *actually*. We will now argue that the interactions between tenses and *actually* lead us to the conclusion that "AT actual_v" does not correspond to the English expression. In the absence of any reason to introduce "actual_v" on its own, it would therefore be unwise to replace IQ's present tense with a compound containing "actual_v".

Recall that (31) denotes a value-specific proposition; it is either context-free or context-sensitive. Now, consider the untensed sentence of English (32), and its tensed analogue (33):

- (32) Mick actually be ill now
 (33) Mick is actually ill now

If we decide that (31) is context-free, then it may represent (32); (33), meanwhile, could be represented in IQ by adding a $PRES_{(v,t)}$ operator to (31). Syntactically, this is permissible. Semantically, however, it is not clear what this could mean. Suppose that Mick is indeed ill when I utter the sentence (33). (31) denotes a temporally-relative truth value. The semantic function of the $PRES_{(v,t)}$ operator is to say "This is one of the times at which the following proposition evaluates to true". But, by hypothesis, the "following proposition", in this case, is a truth value. It makes no sense to talk of a truth value evaluating to true. It'd be like saying "True is true here". The first alternative, therefore, reduces to semantic incoherence.

If we choose the second alternative, then (31) is context-sensitive. This being so, we cannot apply a tense operator to it; by definition, such operators act only on context-free sentences. If we cannot add a tense operator to (31), we cannot represent (33) at all. To put the point another way: if "AT actual_v" and "AT now_t" constituted a tense operator, the representation of (33) would require tense iteration. As we have previously observed, iteration is only possible if at least one of the parameters inside the embedded sentence is bound out by the G operator. And if the representation of (33) is formed by the simple addition of the $PRES_{(v,t)}$ operator to a context-free sentence, then (31) cannot be the representation of the tenseless sentence (32).

- (34) John actually be drunk yesterday
 (35) John was actually drunk yesterday

Consideration of sentences such as (34) and (35) reveals that the temporal indexical in both cases is acting parametrically. If tenseless sentences such as (34) or (32) are represented by context-free sentences after all, via the use of the G-operator, then it must be because the G is binding the world parameter v attached to "actual _{v} ".

From this, we may conclude that, given the evil operator introduced by the definition (30), either IQ cannot in principle represent the simple tensed sentence of English (33), or else the representation (31) of (32) is incorrect. Since IQ must be able to represent (33), we must infer that if "actual" is defined with a world-parameter, that parameter will, even in the simplest cases (like the representation of (32)), be bound out by G. So, even if IQ did contain a modal indexical, that indexical would never act parametrically when it represented the English *actually*. Temporal indexicals such as "AT now _{t} " and "ON yesterday _{t} " may act either parametrically or non-parametrically; that is one of the major justifications for representing them with parameters. But it seems as though the putative English modal indexical never acts parametrically; it would therefore be a poor indexical indeed.

So, if we construe "AT actual _{v} " and "AT now _{t} " as a covert tense operator, the English word *actually* cannot be represented by the modal indexical suggested in (30). There is nothing in theory to stop this reconstrual of IQ's "PRES_(v,t)" operator. However, there is no independent reason to carry out this change: the English *actually* does not require a modal indexical to represent it. Indeed, if we did insist on introducing the modal indexical to represent *actually*, it would have no occurrence in which it actually acted like an indexical.

This means that "actual _{v} " could help create value-specific propositions in conjunction with temporal indexicals, but that there is so far no good reason for adding it to the object-language of IQ. The role of tense as the only device of assertion need not be rejected. Hence, the danger which threatened at the beginning of this section has begun to recede. It may be significant that, although the belief that expressions such as *actually* or *the actual world* are indexical is widespread, arguments in its favour are hard to come by. David Lewis, with whom the doctrine is often associated, has marshalled some reasons for believing it, which involve alethic modalities (Lewis (1970;1973)). But van Inwagen (1980) has convincingly argued that the only possible interpretations of Lewis's position either make it false, or else render *actual* as a non-indexical; and of course, that's just how *actually* has actually turned out in IQ.

Perhaps, however, IQ should contain another kind of operator which does allow the creation of modally specific propositions; which would, taken with a temporal operator of the appropriate kind, also generate illicit value-specific propositions. By analogy with temporal indexicals and dates, if modal indexicals aren't required, perhaps modal dates are. If dates are regarded as the names of temporal intervals, then modal dates would be the names of worlds. It might be thought that such devices wouldn't suffer from the problems which the attempt to construe *actually* as a modal indexical ran into. Yet while it was quite easy to conjure up an English expression that at least sounded like a modal indexical, there are no promising candidates for world-names in natural language.

For the sake of argument, however, suppose that "U" is the name of a nonactual world, and that somehow or other, I can refer to U using only the resources of the object-language of IQ. Then the truth clauses for "AT U" would be analogous to those for a temporal date:

- (36) AT U (A) is true in M at (w,i) if $w=U$ and A is true in M at (w,i); it is false at (w,i) if either $w \neq U$ or A is false at (w,i); and otherwise it is undefined.

Now, just as it is possible to create value-free propositions, like that expressed by the sentence (37), which evaluate to true for only one interval by using dates (or indexicals), it should be possible to create value-free propositions which evaluate to true for some one world by using "U". (39) is the modal analogue of (37).

- (37) Sally be in London at 6pm on 1/4/86
 (38) Sally was in London at 6pm on 1/4/86
 (39) Sally be in London at U
 (40) Sally was in London at U

(40) will be represented by the context-sensitive sentence (41).

- (41) $PAST_{(v,t)}$ [AT U (Sally be in London)]

(41) will be true in model M at (w,i) if $w=g_c(v)$, $i=g_c(t)$ and there is an interval j earlier than i such that (42) is true at (w,j).

- (42) AT U (Sally be in London)

(42) will be true at (w,j) if $w=U$ and (43) is true at (w,j).

- (43) Sally be in London)

But if U names a non-actual world, as we claimed, then the sentence will never be true, since $w=g_c(v) \neq U$. So either no simple sentence involving the name of a nonactual world is true, or U must be the speech world after all. On the one hand, if every such sentence is

false, it is hard to see how modal dates could be informatively introduced into IQ at all. On the other, if "U" names the speech world, then the exactly the same comments which applied to "actual_v" apply to it too. It is certainly possible, and in IQ essential, to refer to worlds metalinguistically, but it seems that neither natural language nor our current version of IQ has the resources to refer to worlds in the object-language, other than via the tenses.

We cannot here give full justice to alethic modalities involving possibility and necessity, which might give "actual_v" a role. However, we may conclude for the moment that in IQ as it stands, there is no apparent need to gerrymander propositions which are modally but not temporally specific; because of this, we can't create value-specific propositions without using a tense operator to make an assertion. That this should be so is perhaps not very surprising, but it is reassuring. The asymmetry between the temporal and modal expressions, and the acceptability of temporally specific value-free propositions as opposed to modally specific propositions, can perhaps be traced to the following facts. In the case of time, a human language user may be located in different temporal positions for her various utterances. As a result, she may have, at different positions, different perspectives on the same entities. In the case of worlds, the language user never seems shift perspective; she only ever has one modal perspective: the actual one. IQ is designed to reflect the semantic structure of temporal expressions in English; on this basis, neither modal indexicals nor world-names fit into the object-language of IQ. Thus, there is no way of quietly smuggling value-specificity into the semantics: one must do it with all the sound and fury of a tense operator.

It was observed at the beginning of section 5.1 that Richards regards "value-specific" and "value-free" as "terms of art" rather than as purely technical notions. It was claimed at the time that we would show that the terms do have technical content. Why does Richards think that the terms don't denote a distinction at the denotational level? The reason lies in the following facts. The value-specific proposition denoted by a true utterance of a sentence is a function which takes one particular world-time pair to the True. Now, a value-free proposition is a function from world-time pairs to truth-values; there is no immediate reason why it shouldn't just happen to be the case that a value-free proposition takes only one world-time pair to the True. So, at the denotational level, there may be some value-free propositions which look just the same as value-specific propositions.

We have been concerned to show that the introduction of temporally specific propositions doesn't undermine the value-free/value-specific distinction. If the distinction itself doesn't

really matter, it might be argued that there is no point in getting worried about temporal specificity. However, there are two points to make here. First, the terms are introduced in order to correspond to the sentences of the representational language which denote them. Another way of expressing the problem which temporally specific propositions might present is in terms of the context-free/context-sensitive distinction. In those terms, the problem is: do temporal indexicals undermine the assertive power of tenses? We have in fact looked at the problem in these terms both in sections 5.1.3 and 5.1.4, and in Chapter 3. To say that indexicals do not undermine tenses is, in a sense, another way of saying that temporal specificity does not threaten unwanted value-specificity, thanks to the modal aspect of tenses.

The second point is that, given our brief discussion of modality, there are strong reasons for thinking that the pseudo-value-specific propositions mentioned above are not possible entities in IQ. The fact that singular reference to other worlds is not possible suggests that value-free propositions which evaluate to true for only one world will never occur; if we don't force such propositions into existence using special operators, then it seems unlikely that they exist at all ²⁹. Therefore, it might just be that value-free propositions are never sufficiently specific to worlds to be confused with value-specific propositions.

Taking these two points together, it can be seen that temporal specificity is certainly a significant issue, and constitutes an important property of the semantic entities corresponding to sentences containing indexical expressions. Sections 5.1.1 to 5.1.4 have shown that IQ has resources rich enough to portray rather subtle distinctions among the contents expressed by natural language utterances. Having sketched a map of the territory, it would now perhaps be fruitful to compare IQ propositions with Kaplan's contents; this is the task tackled in the next section.

5.2 Kaplan's Content Revisited

The previous section should have made clear that while value-free propositions are to be distinguished from the value-specific, there is more than one way to be value-free. On the one hand, there are some propositions which are neither temporally nor modally specified. On the other, there are some value-free propositions which are in fact temporally specified. Although one of the parameters has had its value supplied, the other has not, and so the

²⁹ The fragment IQ*, discussed in Chapter 6, contains an actuality operator so that IQ* may be fairly compared with Kaplan's (1979) Logic of Demonstratives. However, the operator is of a harmless variety, and cannot force single-world truth.

overall proposition is still value-free.

Whether or not there should be such entities as temporally specific value-free propositions is a substantive question; although our treatment of indexicals within the IQ framework suggests that these propositions are legitimate semantic entities, others have not looked upon them with such favour. For instance, Kaplan (1977) argues that the proposition in his system, which is identified with the content of a sentence in a context, does not involve such temporal specificity. Since his discussion of this issue is his most extended treatment of the temporal status of propositions, it is well worth detailed examination. Significantly enough, Kaplan cannot ultimately be committed to the view that none of his contents are temporally specific; so where we portray his views in this way, we are engaging with a straw man. The examination will serve a dual purpose: first, it will enable a critical view of temporally specific propositions to be surveyed; secondly, it will allow us to establish the relationship between Kaplan's contents and IQ propositions.

(44) Colin is in Edinburgh

(45) Colin is in Edinburgh now

Kaplan's major concern is with the proposition expressed by an utterance of a sentence such as (44); (45) is relevant because he at one point offers it as a paraphrase of (44). Suppose that (44) and (45) are both uttered at the world-time index (w,i) . Then the correct representations for the utterances are those given in (46) and (47) respectively, given that $g_c(v)=w$ and $g_c(t)=i$.

(46) $PRES_{(v,t)}$ (Colin be in Edinburgh)

(47) $PRES_{(v,t)}$ [AT now_t (Colin be in Edinburgh)]

(46) and (47) both denote value-specific propositions. That is to say, if they are true utterances, then they denote the function which takes at most one world-time pair to true. If the utterance of (44) is true at (w,i) , then the utterance of (45) will be true there also; (46) and (47) denote the same value-specific proposition. However, the utterances of (44) and (45) say different things: the latter is more specific than the former. In the terms of the previous section, the value-free proposition denoted by (49) is temporally specific, whereas the value-free proposition denoted by (48) is not. (48) and (49) denote different, but related, value-free propositions.

(48) Colin be in Edinburgh

(49) AT now_t (Colin be in Edinburgh)

In fact, supposing that i is 2pm on the 19th of September 1985, the second value-free proposition is the same as the one denoted by (50):

- (50) Colin be in Edinburgh at 2pm on 19/9/85

According to Kaplan, the second of these propositions involves a degree of redundancy, since it incorporates reference to a specific time. The question, as far as he is concerned, is whether we should render the utterance of (44) as expressing the propositional content given in (51) or the propositional content given in (52) ³⁰.

- (51) Colin is in Edinburgh
(52) Colin is in Edinburgh at 2pm on 19/9/85

These representations differ in a small but significant way from the IQ representations (48) and (50): Kaplan's candidates contain present tense verbs. There are two explanations for this difference: first, the *is* in (51) and (52) is tenseless, so that there is no real difference between the IQ propositions and the Kaplan contents; secondly, the *is* in (51) and (52) is a genuine present tense verb, and the Kaplan contents straddle the distinction made in the IQ system between value-free and value-specific propositions. Although the latter is perhaps closer to the truth, we shall treat the *representations* of the value-free propositions as if they were very nearly the same objects as the *representations* of Kaplan's contents. On this assumption, the contents represented by (51) and (52) correspond to the value-free propositions denoted by (48) and (50). As we have already stated, (48) denotes the value-free proposition expressed by the utterance of (44) at (w,i).

- (44) Colin is in Edinburgh
(48) Colin be in Edinburgh

Thus, the IQ analysis suggests that we should agree with Kaplan in asserting that (51), which is the analogue of (48), represents the content of the utterance. Now, although this means that our view of the content of an utterance containing no explicit indexical expressions coincides with his, the IQ position is substantiated by the arguments deployed in the previous section; by contrast, Kaplan's arguments against taking (52) as the content of the utterance of (44) appear to stand against the possibility of temporally specific propositions. A careful examination of those arguments should show that, in spite of appearances, Kaplan cannot be opposed to the possibility of temporally specific propositions; and that where he is opposed to their use, so too is IQ.

In Footnote 11 to Kaplan (1977), the author observes that the proposition (52) is specific as to time, whereas the "proposition" (51) is neutral with respect to time. The scare quotes are Kaplan's; he invokes them because he feels that (51) is not the traditional notion

³⁰ Note that (51) is Kaplan's propositional content, and although it looks just the same as the sentence (44), it would not be a wff of his object-language.

of proposition. Although it is not traditional, he believes it to be right; and, with certain reservations, a proponent of IQ could agree with him. First, then, let us see what happens if the content of the utterance at (w,i) of (44) is taken to be (51), as both the IQ and Kaplan analyses would indicate. In this case, it makes sense under the Kaplan analysis to ask whether the content would be true at times other than i. According to Kaplan,

[W]e think of the temporally neutral "proposition" as changing its truth value over time. Note that it is not just the non-eternal sentence (44) that changes its truth value over time, but the "proposition" itself ... [S]ince the sentence contains no temporal indexical, the time of the context will not influence the "proposition" expressed. [Kaplan 1977:105]

On our analysis, the value-free proposition does not have a truth value, and thus, the value cannot change over time. On the other hand, the value-free proposition can be regarded as a function from world-time pairs to truth values, and in that sense at least, truth-values associated with it are time-dependent. As Kaplan says, the utterance contains no temporal indexical. As a result, the time of the utterance does not influence the *value-free* proposition expressed at all. Naturally, the time does influence the value-specific proposition denoted; if the time delivered by $g_c(t)$ were not i, the value-specific proposition would not be that denoted by (46), but some other value-specific proposition.

(46) $PRES_{(v,i)}$ (Colin be in Edinburgh)

It might be either the false value-specific proposition, or else a distinct value-specific proposition which takes a different world-time pair to true.

A second possibility is to take the verb tense in the utterance of (44) to involve an implicit temporal indexical, so that the correct representation of the utterance is not (46) but (47).

(47) $PRES_{(v,t)}$ [AT now_t (Colin be in Edinburgh)]

Now although our analysis of tense shows it to involve a deictic element, that element is realised (both syntactically and semantically) as part of the tense operator. For this reason, the representation we have adopted already has both an implicit temporal indexical and an implicit modal indexical attached to tense. The representation (47) is distinct, in that it involves an explicit temporal indexical. Kaplan errs, therefore, in claiming that this second option requires us to view the content of the utterance (44) as being (52) rather than (51). The value-specific IQ proposition involves implicit indexicals, but it maintains that the value-free proposition expressed by the utterance of (44) is still (51).

(51) Colin is in Edinburgh

(52) Colin is in Edinburgh at 2pm on 19/9/85

If (52) really were the content of the utterance, then Kaplan is close to the truth when he

states

In this case what is said is eternal; it does not change its truth value over time, although (44) will express different propositions at different times. [Kaplan 1977:105]

Not only will the value-specific proposition be different at different times; the value-free proposition expressed by different utterances will be different, depending on the time of utterance. If the sentence is uttered at 3am on the 1st of October, then the temporally specific value-free proposition expressed is that represented in (53):

(53) Colin be in Edinburgh at 3am on 1/10/85

Kaplan then offers a series of points aimed at proving that the content of (44) at (w,i) is (51) rather than (52). They are all significant observations, but they do not actually count against the IQ propositions; indeed, they help to lay bare the relationships holding between content, value-specific and value-free propositions. He first makes a philosophical point:

[W]e may ask why the temporal indexical should be taken to be implicit (making the proposition eternal) when no modal indexical is taken to be implicit. [Kaplan 1977:105]

As we have already noted, the IQ framework demands that there is not only an implicit temporal indexical, but also an implicit modal indexical. Presumably, then, it escapes Kaplan's censure; however, it does not indicate that (52) is the content of the utterance of (44), for the parameters only occur in (46), which denotes the relevant value-specific proposition, not in (48), which denotes the value-free proposition (which corresponds in turn to the content-proposition (51)). (52) is the content of the distinct utterance of the distinct sentence (45), which does in fact contain an explicit temporal indexical, but no explicit modal indexical. Kaplan goes on to ask:

Is there some good philosophical reason for preferring contents which are neutral with respect to possibility but draw fixed values from the context for all other features of a possible circumstance whether or not the sentence contains an explicit indexical? [Kaplan 1977:105]

There is indeed a good reason for allowing in temporally specific value-free propositions; however, there is nothing to stop us from introducing modally specific propositions as well. It so happens that this is just what IQ tense does, converting value-free propositions into value-specific propositions, which are neutral with respect to neither possibility nor time. Allied to this point is the answer to Kaplan's next claim, which he regards as a more technical point:

[W]e must note that intensional operators must, if they are not to be vacuous, operate on contents which are neutral with respect to the feature of the circumstance the operator is interested in. Thus, for example, if we take the content of the utterance of (44) to be (52), the application of a temporal operator would have no effect; the operator would be vacuous. [Kaplan 1977:105]

In fact, of course, the application of the temporal operator is not only not vacuous; it is

actually essential for making an assertion about the truth of the proposition (52). Naturally, we would maintain that such an assertion could be made with an utterance of (45) rather than of (44);

- (44) Colin is in Edinburgh
- (45) Colin is in Edinburgh now

However, there is a grain of truth in what Kaplan says, for it so happens that tense operators can only apply to context-free sentences; that is, they can only apply to sentences which do not contain undeparametrized tenses. They can, however, operate on contents which are neutral with respect to only *one* of the *two* features the operator is interested in. This amounts to saying, of course, that the temporally specific value-free propositions expressed by sentences containing explicit indexicals are still grist to the tense mill. Kaplan then notes that

[I]f we do not wish the iteration of such [temporal] operators to be vacuous, the content of the compound sentence containing the operator must again be neutral with respect to the relevant feature of the circumstance. This is not to say that no such operator can have the effect of fixing the relevant feature and thus, in effect, rendering subsequent operations vacuous; indexical operators do just this. [Kaplan 1977:105-6]³¹

By syntactically excluding the possibility of tense iteration, Richards in fact ensures that the compound sentence is not neutral with respect to possibility or time. And this is hardly surprising, since his tense operators are a form of indexical operator; like indexicals, they are parametric expressions when rendered in the language of IQ. Interestingly enough, the fact that Kaplan allows indexical operators to fix relevant features means that he must actually permit the existence of temporally specific contents after all, although this is not a point to which he draws much attention. Therefore we cannot construe Kaplan as having shown that temporally specific value-free propositions are impossible; merely that they are not expressed by utterances of sentences which contain no explicit indexical. That much both systems agree upon. However, the value-specific IQ propositions are both temporally and modally specific, and these propositions are expressed by sentences which need not contain an explicit indexical. In this respect, the systems diverge. We can now see how the assumption that Kaplan's propositional content (51) was the same as that denoted by our (48) obscured an important point: the utterance of the sentence (44) at (w,i) both denotes a temporally (and modally) specific proposition - the value-specific proposition denoted by the IQ sentence (46) and expresses a temporally (and modally) unspecified proposition - the value-free proposition denoted by the IQ sentence (48).

³¹ It is argued in Chapter 6 that the notion that indexical operators may render subsequent operations vacuous is a bug, not a feature, of Kaplan's account; the problem relates to tense/indexical interaction, and does not invalidate what is said in the text above.

- (44) Colin is in Edinburgh
- (46) PRES_(v,t) (Colin be in Edinburgh)
- (48) Colin be in Edinburgh
- (51) Colin is in Edinburgh

Even so, whether content is like a value-free proposition or a value-specific proposition, what Kaplan says at the end of his footnote can be read so that it is true:

A content must be the kind of entity that is subject to modification in the feature relevant to the operator. [Kaplan 1977:106]

For where a content is a value-free proposition, most contents (like (51)) can be “modified” by tense operators. Temporally specific contents (like (52)) have one relevant feature which cannot be modified by a tense operator, but their other relevant feature can still be modified by the tense operator. Finally, when a content is a value-specific proposition, there is no operator that can legally modify any of its features. A value-specific proposition is denoted by a perfect sentence, in that the proposition incorporates “specific values for all features of circumstances”. As Kaplan says,

Any intensional operators applied to *perfect* sentences are redundant. [Kaplan 1977:22]

IQ goes one better: an intensional operator such as a tense applied to a sentence which is perfect in virtue of already being tensed is not only redundant; it is semantically ill-formed, as the clauses for the language IQ* given in Chapter 6, section 3.2 show.

The view of propositions arrived at in the previous section dictates answers to questions that Kaplan raised. Those answers are compatible with much of what he said; but the apparatus of extended IQ allows us to express those answers in a more subtle way, at the same time letting us see the differences between our propositions and Kaplan’s contents. Since Kaplan contrasts his view of propositions with a more traditional view, it would be worth examining the notions at work in both Frege and Russell. This is the task of the next two sections.

5.3 The Fregean Connexion

There are some very obvious similarities between the distinctions which can be drawn among the semantic entities of IQ and those introduced by Frege. While the similarities are not to be underestimated, in this section we shall place more emphasis on the differences; in the next section, we’ll play the Russellian card. Now, we shall first discuss some of Frege’s comments on direct and indirect reference in order to demonstrate that IQ is fairly Fregean with respect to semantic innocence; we will then go on to examine the differences which arise concerning sense, assertion and temporal specificity. It should be emphasised

that this section does not aim to provide, even in outline, a Fregean semantics for natural language. Rather, it compares certain aspects of the semantic entities developed as part of the Fregean enterprise with aspects of the propositions of IQ. The same goes, *mutatis mutandis*, for the examination of Russell in section 5.4.

5.3.1 A Question of Innocence

One respect in which IQ seems to follow Frege lies in its abandonment of semantic innocence. For this reason it might be imagined that IQ can't really be Russellian after all; Barwise and Perry (1983) certainly seem to think that innocence is the keystone of neo-Russellian semantics. But the situation is not quite as simple as this. IQ is indeed semantically guilty, but its crime is rather a sophisticated one. In order to understand properly where it stands on the question of innocence, we must be clear about the notion itself.

Donald Davidson introduced the question of innocence in the following terms:

If we could recover our pre-Fregean semantic innocence, I think it would seem to us plainly incredible that the words 'The earth moves', uttered after the words 'Galileo said that', mean anything different, or refer to anything else, than is their wont when they come in other environments. [Davidson 1968:146]

What Davidson is disputing is Frege's distinction between direct and indirect reference. That distinction was introduced to explain the failure of the principle of substitutivity in oblique contexts:

In indirect speech, words are used *indirectly* or have their *indirect* reference. We distinguish accordingly the *customary* from the *indirect* reference of a word; and its *customary* sense from its *indirect* sense. The indirect reference of a word is accordingly its customary sense. [Frege 1892:159]³²

Davidson wanted a return to a semantics without the direct/indirect distinction, and attempted to do without it in his paratactic analysis of indirect speech reports. It is clear from Richards' discussion of such reports in relation to Davidson's position that he believes that embedded tenses in English provide counter-examples to Davidson's claim:

Certain tense phenomena lend support to the view that oblique contexts are not semantically innocent. The "relational" import of tenses in oblique contexts is not always the same as their import in main clauses. [Richards 1986:177]

For example, the words *Bush was a great President* really do seem to mean something different when uttered after the words *Someone will say that* than they do in other environments. The difference is that when embedded in this way, the words cannot be taken to mean that Bush occupied the position of President before the time of the utterance of the

³² All page references to Frege are to the works as they appear in Frege (1984), edited by McGuinness. The dates given, however, are those of the original articles. The quotations here use "reference" instead of

speech report, which is what they would mean if they stood alone. In other words, when the words are embedded, they do not invoke reference to time in the normal way. Furthermore, the indexicals studied in Chapter 4 provide further counter-examples to Davidson's plea for innocence. In some contexts, indexical expressions do not act parametrically; among these contexts are quantified indirect speech reports. They too do not invoke reference to time in the standard way: *tomorrow* need not mean the day after the day of speech. So, if the analysis of embedded tenses and indexicals offered in Chapter 4 is accepted, we might not only admit that IQ is guilty, but also question the virtues of innocence.

Barwise and Perry (1983:176) strongly advocate these virtues, and it is useful to note their conditions on an innocent semantics for attitude reports.

- (54) Embedded sentences in attitude reports are syntactic units, parts of the embedding report and expressions in them work just as they do elsewhere.
- (55) Names, pronouns and referential and (outer) attributive uses of definite descriptions have individuals, not senses or meanings or functions, as their semantic values.
- (56) The principle of substitution of logical equivalents fails.

Barwise and Perry's reworking of Davidson's notion is remarkable for at least one reason: it makes Davidson's own paratactic account a guilty one, since it fails the syntactic aspect of condition (54). Barwise and Perry would return a guilty verdict on IQ too, although we must be clear about the extent of that guilt.

IQ may avail itself of a standard Montagovian treatment of singular terms in oblique contexts; if it does, then only one element acts differently in oblique contexts, and that is tense. Strictly, tense is not realised as a distinct expression of English. It is, however, in the language of IQ; but there we have two distinct expressions in normal and oblique contexts: parametric and non-parametric tenses. We don't have one expression with a two different types of meaning. Non-parametric tenses may occur outside oblique contexts; this happens in sentences involving tense scoping. But fully parametric tenses never occur in oblique contexts. As we shall see, this means that in this respect, IQ allies itself with a particular approach to the formalization of the doctrine of direct/indirect reference. Thus, we can see that IQ's guilt attaches primarily to its tenses, which are sentential operators.

So we can distinguish IQ's guilt from Frege's. For while Frege distinguishes the customary and indirect reference of words, IQ actually draws the distinction at a sentential level. In

McGuinness's "meaning", not because it might be more accurate, but simply to conform with general practice.

Frege's terms, we must say that for IQ, it is not the case that words are used indirectly in indirect speech; it is the tense of the sentence which is used indirectly. We could go further, and say that it is not the case that the indirect reference of a word is its customary sense; but the indirect reference of a sentence is its customary sense. To translate into the terminology of IQ, we distinguish the reference that a sentence has in oblique contexts (where the sentence occurs as an argument to a relation) from its reference when it stands alone. We might say that for some given sentence, which may occur either alone or in an oblique context, its customary reference is a value-specific proposition; its customary sense names a value-free proposition; and its indirect reference is the value-free proposition named.

So the suggestion made in connexion with Barwise and Perry's innocence conditions points to the real difference between IQ and Frege: Frege is guilty deep down at the word level, but the only thing guilty about IQ is its sentence. It might be thought that bound indexicals are guilty at the word level, but they occur only in quantified speech reports, which don't appear to bother either Davidson or Barwise and Perry. So, IQ follows Frege in that the words *The earth moves* may have a value-free proposition or a value-specific proposition as their reference, depending on the context of their utterance. But the semantic difference is not located in the words themselves; it is in the tense, which operates at a sentential level only. It is interesting here to note what Davidson said just before the passage quoted above:

Since Frege, philosophers have become hardened to the idea that content-sentences in talk about propositional attitudes may strangely refer to such entities as intensions, propositions, sentences, utterances, and inscriptions. What is strange is not the entities, which are all right in their place (if they have one), but the notion that ordinary words for planets, people, tables, and hippopotami in indirect discourse may give up these pedestrian references for the exotica. [Davidson 1968:146]

What he doesn't like about semantically guilty parties is indirect reference for referring expressions; and to abandon innocence at the sentential level does not entail forcing words for planets and people to refer indirectly. So, IQ's crime would be less than Frege's, in the eyes of Davidson.

5.3.2 Sense and the Hierarchy

Frege identifies the reference of an assertoric sentence with its truth value (the value-specific proposition, as it were), and the sense of the sentence with the thought expressed (the value-free proposition). The sense of an expression is what we know when we

understand it; the thought expressed by a sentence is that for which the question of truth arises. Thoughts are traditionally identified with senses, and it is this identification that we were trading on when we started to reconstruct Frege's sense/reference distinction in IQ terms above.

Value-free propositions correspond to thoughts expressed, and value-specific propositions correspond to truth-values denoted. But does sense make sense in IQ? We investigate this question in order to highlight both striking correspondences and certain basic differences. In particular, since IQ introduces two kinds of tense expression, one of which never occurs in oblique contexts, we can pose the following question. Is IQ committed to an intensional hierarchy of the kind taken to be a problem for Fregean accounts? Will IQ suffer from the analogues of senses of senses of senses, and the like? That is the basic issue tackled in this section; before discussing it, however, it's worth pointing to where we will be going afterwards.

We said that thoughts are traditionally identified with senses. Now, the identification might be traditional, but it is not necessary. And this is just as well, since Perry (1977) has argued that the identification cannot be maintained if the Fregean is to adequately explain indexicals. In section 5.3.3, we will consider Perry's position on the temporal specificity of thoughts, and his rejection of the sense/thought identity. We will not actually commit ourselves to Perry's analysis of Frege. However, the the running theme of this chapter is the ability of IQ to express subtle distinctions; they need not be the ones that latterday Fregeans regard as faithful to their forebear. In particular, we will be concerned to show that IQ can represent the distinction that Perry is concerned to draw.

However, questions arising concerning the hierarchy of senses can be posed independently of the sense/thought identity; as Burge (1979:273) explicitly states, his argument for the hierarchy does not depend on a commitment to truly Fregean senses. Since this is the case, and since Perry's notion of sense can be interpreted as one for which Burge's argument is still relevant, we shall discuss in the next few sections the reasons why a hierarchy of senses might be generated, and why IQ avoids such a hierarchy.

Where could the hierarchy arise? When we turn to oblique contexts, we find the following situation:

The case of an abstract noun clause, introduced by 'that', includes the case of indirect quotation, in which ... the words ... have their indirect reference, coincident with what is customarily their sense. So here, the subordinate clause has for its reference a thought, not a truth value and for its sense not a thought, but the sense of the words 'the thought that (etc)', which is only a part of the thought in

the entire complex sentence. [Frege 1892:166]

In the sentential scheme of IQ, the reference of the abstract noun clause is a value-free proposition; this is not just a coincidence, of course; because tense iteration is forbidden, no context-sensitive sentence could be embedded within another, and thus the embedded clause could not refer to a value-specific proposition anyway. But if the reference of the abstract noun clause is a value-free proposition, what is the sense of the clause? In the Fregean tradition, one is faced with a serious problem at this point. If it is assumed that the sense of a subordinate clause differs from the sense of that clause when it occurs as a simple sentence, then it can be argued that there must be an infinite hierarchy of senses. IQ, we shall argue, does not invoke such a hierarchy; in order to put this point in context, we shall briefly discuss the views of Burge (1979) and Dummett (1973).

5.3.2.1 Creating the Hierarchy

Our discussion of indirect speech reports in Chapter 4 was exclusively concerned with single oratio obliqua. However, speech reports can be embedded arbitrarily deeply, within other reports. The simplest example of this occurs in double oratio obliqua, such as (59).

- (57) Gottlob was German
- (58) Saul said that Gottlob was German
- (59) David said that Saul said that Gottlob was German

(57) occurs within the speech report (58), which itself is reported in (59). The existence of sentences such as (59), together with the supposition that the sense of a clause in an indirect speech report differs from its sense when it stands alone, can be taken to imply the existence of an infinite hierarchy of senses, for the following reasons. The reference of (57) when it stands alone is a truth value (indeed, it is the truth value true); according to Frege, its sense is the thought that Gottlob was German.

Consider now (57) when it occurs as part of (58). The reference of (57) in this context is the sense of (57) standing alone. Now, it is assumed that if the sense of A is the same as the sense of B, then the reference of A is the same as the reference of B (this corresponds to Burge's third assumption, below). So if the sense of (57) in (58) is the same as the sense of (57) standing alone, then the reference of (57) in (58) is the same as the reference of (57) standing alone. But the reference of (57) standing alone is the truth value true; and "Saul said that True" is not an acceptable paraphrase of (58). We must therefore conclude that the sense of (57) in (58) is not the same as the sense of (57) alone. The sense of the embedded (57) must be some other entity. Call this entity the indirect sense of (57). We

know that the indirect reference of (57) is its ordinary sense, but given that “there is no backward road” from reference to sense, this does not determine what the indirect sense is. Dummett (1973:267) observes that Frege’s own suggestion (mentioned in the passage above) is rather implausible, for we would have to say that the indirect sense of *Socrates* is the same as the ordinary sense of *the sense of ‘Socrates’*.

Now take (57) as it occurs in the sentence (59). (57) occurs within the clause (58) which follows the first *said that*. Its reference must be the sense it would have in (58) taken as a complete sentence. But we have just stated that in (58), (57) has its indirect sense. So in (59), the (doubly indirect) reference of (57) will be its indirect sense. And the sense of (57) will be its doubly indirect sense. And according to Dummett, if we can’t say what the indirect sense of an expression such as (57) is, we can’t say what its referent is when it appears in double oratio obliqua such as (59). Hence we could not even work out the truth value of (59). Furthermore, we can see that the introduction of indirect sense has forced us to supply doubly indirect senses, and that this will be only the beginning of an infinite hierarchy of senses.

5.3.2.2 Burge and the Hierarchy

Such a hierarchy is generally regarded as undesirable, and Dummett provides a solution to the problem which apparently blocks its creation. Burge (1979) has urged, however, that given that there are two major methods of formally representing reference shift implicit in Frege’s writings, it can be argued that both invoke a hierarchy at some point. Dummett’s attempt to avoid the hierarchy takes place within Method I; IQ, as we shall indicate, falls roughly within Method II. Since Burge uses one set of arguments to show that Method I involves a hierarchy, and another to show the same for Method II, we shall mainly be concerned to show why the arguments fail in the latter case, rather than the former.

Briefly, by Method I, the hierarchy is avoided by observing that the reference of an expression is not determined by sense alone, but must be determined by sense and syntactic context taken together. According to this method, clauses such as (57) have but one sense, which will determine different references according to the linguistic context. We should “never ask for the reference of a word in isolation, but only in the context of a sentence”, according to Frege (1884:x). An expression will have a sense independent of linguistic context, but only gain a reference with respect to context. So clauses such as (57) within opaque contexts such as (58) have the same sense as they have on their own, but they have

different references in the two cases. Thus, as Dummett says,

There is therefore no reason to think that an expression occurring in double oratio obliqua has a sense or a reference different from that which it has in single oratio obliqua: its referent in double oratio obliqua will be the sense which it has in single oratio obliqua, which is the same as the sense it has in ordinary contexts, which is the same as its referent in single oratio obliqua. [Dummett 1973:268-9]

Now, as Burge observes, Method I requires the relativization of the referent of an expression to its syntactic context. Thus, the truth conditions for expressions of a formal language will become rather more complex in order to deal with this perturbation. He goes on to argue [pp275-8] that if the hierarchy is avoided in the object-language, a metalanguage of the same general form cannot provide a systematic truth theory for the object-language. His argument to this conclusion assumes the success of his argument against the possibility of avoiding the hierarchy on the Method II construal of Frege's distinction between direct and indirect reference.

Whereas Method I kept the representation of expressions simple by elaborating the truth conditions for those expressions, Method II elaborates the representations and keeps the truth conditions independent of syntactic context. In essence, Method II assumes that there will be at least two formal translations of each natural language expression. Burge would have the natural language expression *Gottlob* translated in two different ways, depending on the linguistic context in which it occurred. So the difference between Methods I and II is basically the difference between structural and lexical complexity. Method I keeps the object-language syntactically simple at the price of semantic complexity; Method II keeps the semantics of the language simple, at the price of syntactic complexity. It should be noted that Method II would still have to define the the set of natural language syntactic contexts which cause reference shift.

5.3.2.3 IQ and the Hierarchy

The approach which IQ takes towards indirect speech reports is basically a sophisticated version of Burge's Method II. We complicate the object-language by having two types of tense (parametric and non-parametric), while still keeping the syntax comparatively simple by deriving one from the other (via the G-operator). In this case, the syntactic contexts which force different representations for natural language expressions are *says that* contexts. As we noted in section 5.3.1, there is only one natural language construction which is systematically represented differently, namely tense. For this reason, of course, the possibility of an infinite hierarchy arises at the clausal level alone. The question is: does Burge's

argument for the hierarchy on Method II force IQ into anything like an infinite hierarchy of senses, senses of senses, and so on? The answer is no, and the reason is that IQ does not share all the assumptions Burge must make to get his argument off the ground.

By considering double oratio obliqua such as (60), Burge aims to show that Method II either reduces to absurdity or must invoke a hierarchy [pp271-5].

(60) Igor believes Bela believes Opus 132 is a masterpiece

His claim is that on a plausible set of assumptions, we start out by interpreting *believes* as a relation between individuals and propositions, and end up interpreting it as a relation between individuals and truth values. From this, we can easily show (by classical substitutivity) that if what Bela believes is true, then he believes every truth. To escape from this absurd conclusion, Burge offers the Fregean move of using a new term for each successive level of embedding; each term will therefore constitute an expression of a higher intensional level. Now, we can show that IQ does not need to make this move. Burge makes (and discusses) four crucial assumptions. First, he assumes the principle of extensionality. Secondly, he claims that a given sense is associated with a unique denotation, which in the case of a proposition is a truth value. Thirdly, he assumes that this truth value is a function of the unique denotations associated respectively with the senses that determine the proposition. Finally, he assumes classical substitutivity. IQ cannot accept the second of these assumptions, for two reasons.

Firstly, it is not the case that a given sense has a unique denotation, since it is only once extra-linguistic context is taken into account that a sense determines a reference³³. Burge (1979:274) concedes that this principle might indeed be rejected for languages which contain demonstratives, but claims that “these forms of language are not ubiquitous”, and that it is easy to present examples which do not contain them. However, the point about IQ is that indexicals are ubiquitous, given that tense has an indexical character. It is doubtful whether there are any natural languages which do not contain semantic devices corresponding to either indexicals or tenses. Anyway, given this fact about the representational language of IQ, we must note that a given sense has a possibly infinite set of denotations associated with it, where denotations are thought of as (temporally indexed) truth values. To put this point more directly, the value-free proposition expressed by an assertoric sentence is simply a function from world-time indices to truth-values. A given value-free proposition may evaluate to true or false, depending on where it is expressed.

³³ This contrasts with Dummett’s point about sense determining reference only when linguistic context is taken into account. Notice that if a Fregean uses possible worlds, she is committed to this first point; Burge avoids such a commitment only because he also avoids possible worlds.

The second reason for rejecting Burge's assumption is closely linked. It is simply not the case that a given sense is always associated with a truth value. This is just where Burge's argument goes wrong, for he assumes that the expression which expresses a proposition denotes that proposition's truth value. For IQ, when the expression which expresses a proposition contains only deparametrized tenses, that expression does not denote a truth value at all: it denotes a value-free proposition. Indirect speech reports (single, double oratio obliqua, or worse) are just the contexts in which we cannot add extra-linguistic context to the sense of the clause, and thereby derive a truth-value. In other words, the expressions which do denote truth values are never embedded. Since IQ doesn't resort to representing indirect speech with expressions whose denotations are truth values, IQ doesn't fall into Burge's trap. Someone who believes a truth doesn't believe everything. In fact, IQ as it stands deals with speech rather than belief, but it can still show something rather pleasing, which is that someone who says something true doesn't thereby say everything true. And of course, it should be possible to generalise the treatment of indirect speech reports to other oblique contexts.

So, IQ as a Method II strategy overcomes Burge's argument by denying a crucial assumption. From this, we may conclude that the intensional hierarchy cannot be smuggled into IQ through its treatment of indirect reference³⁴. But we don't yet seem to have answered the question with which we started section 5.3.2. If the reference of an abstract noun clause is a value-free proposition, what is the sense of the clause? One way of answering this question was adverted to in the last paragraph. When the expression which expresses a proposition contains only deparametrized tenses, that expression doesn't denote a truth value; it denotes the value-free proposition which it expresses. So the expression denotes and expresses the same value-free proposition. Now, if it is assumed with Frege that the sense of a sentence is the thought expressed by the sentence, we might want to say that, for IQ, the sense of a sentence is the value-free proposition expressed by the sentence. As with sentences, so too with abstract noun clauses: the sense of the clause would be the value-free proposition expressed by the clause. But that's just the same as the value-free proposition denoted by the clause. So, on this account, the sense of an abstract noun clause is the same as its reference, whether that clause is in single, double or triple oratio obliqua. Hence, there is no hierarchy of n-th order senses in IQ, because within indirect speech contexts, sense is reference.

But that particular story depends on the identification of a sense with a thought, and in

³⁴ Another way to avoid the hierarchy is to use Wallace's (1972) ploy of reading all propositional attitude sentences relationally. The hierarchy is short-circuited because in this case, there is a road back from reference to sense. Cf also Burge (1977) on the semantic and epistemological bases for giving belief *de re* priority over belief

section 5.3.3 we will consider a way of systematically distinguishing them. For the moment, the point is that if Burge concedes the identity, then IQ can escape the hierarchy; below we shall show that, even if the identity is rejected, IQ is safe. Whichever course we take, IQ dictates the following position: a context-sensitive sentence of the language denotes a truth value and expresses a value-free proposition. The corresponding context-free sentence (whose tenses have been deparametrized) denotes that same value-free proposition, and expresses it too. Interestingly enough, the abstract noun clause in IQ always occurs in the scope of the description-forming "that" operator. As a result, there is a sense in which IQ signals the natural language contexts which cause indirect reference, just as Burge suggested either Method should.

5.3.3 Temporal Specificity Again

In this section, we'll note briefly a standard interpretation of Frege's remarks on indexicals, and then outline the moves that Perry (1977) suggests are necessary to avoid problems with the Fregean treatment of indexicals. It's significant that Perry puts time into the thoughts themselves, unlike Frege, but just like IQ. Finally, we will note that Perry's distinction between the sense of a sentence and the thought expressed by that sentence is already expressible within the IQ framework. As we mentioned above, Perry's points are considered in order to draw out further features of IQ, not to add to the already enormous literature concerning Frege's attitudes to context-dependent expressions. Therefore, no commitment to Perry's particular analysis is intended. For cogent criticism of Perry's analysis, see Burge (1979a:429), Evans (1981:296-303) and Butterfield (1986).

As to the existence of temporally specific propositions, Frege himself is slightly vague. It seems at one point as if he is willing to build the time of utterance into the thought; it must be this vision of propositions that Kaplan considers to be traditional. However, with the benefit of hindsight, it's possible to detect a certain ambiguity in the way Frege goes about temporal specification:

If a time-indication is conveyed by the present tense one must know when the sentence was uttered in order to grasp the thought correctly. Therefore the time of utterance is part of the expression of the thought. If someone wants to say today what he expressed yesterday using the word 'today', he will replace this word with 'yesterday'. Although the thought is the same its verbal expression must be different in order that the change of sense which would otherwise be effected by the differing times of utterance may be cancelled out. [Frege 1918-19:358]

Frege talks about tense and indexicals as if they both had the same effect on the expression

of thoughts. Indeed, at first sight, it seems as though Frege is willing to allow the time of utterance into the thought via tense. In IQ terms, he would be making value-free propositions temporally specific through their tenses. Except in the case of semi-parametric tenses, however, this should not occur. In standard value-free propositions, even those involving a dead tense, no particular time is part of the proposition.

But this interpretation misses the point: Frege doesn't want to put the time of utterance into the thought at all; he merely wants to put it into "the verbal expression of the thought". Even so, Frege must be committed to something a little stronger than that, for he would maintain that the thoughts expressed by the same sentence containing the same indexicals on two separate occasions may be different. Dummett certainly interprets Frege in this way, and Perry actually criticises Dummett for eventually allowing the value of the indexical in context into the thought itself, on the grounds that such a move does not sit well with the standard interpretation of Frege (Dummett (1973:384), Perry (1977:482-3)). Actually, of course, this is a move that Perry himself makes, admitting that Frege would not have been very happy with it.

Perry (1977) argues that Frege's position on demonstratives (or indexicals) commits him to a difficult view on the sense of indexicals. Perry examines Frege's arguments and shows that the context-sensitivity of indexicals leads to problems. He then offers three ways to escape the problem: the first involves the generalisation of the notion of the sense of a sentence, the second involves the generalisation of the notion of the thought expressed by a sentence, and the third involves the idea that indexicals must provide a sense to complete a thought.

Perry indicates that Frege cannot adopt either of the first two solutions, because they would dictate the abandonment of the sense/thought identity; as a result, Frege must adopt the third solution. Perry argues that this answer, which requires incommunicable senses for indexicals, is spuriously plausible in the case of *I*, but not even remotely plausible in the case of *now*. In the latter case, we would have to believe that each interval of time had a unique, primitive way of identifying it associated with it; and this is undoubtedly false ³⁵.

The only way out, according to Perry, is to break the sense/thought identity. Once this has been done, it is possible to adopt both of the other solutions to systematically distinguish the sense of a sentence from the thought expressed by that sentence. The basic relationship

de dicto. The Wallace move is also open to IQ.

³⁵ Evans (1981:297-8) objects strongly to this argument; he neither believes that Frege would be forced to accept this point, nor finds the "limited thinkability" it implies particularly repugnant.

between sense and thought takes the following form: a sense is a mode of presentation of a thought. The sense of a sentence containing a temporal indexical preserves the means of picking out the time referred to; the thought expressed by the sentence contains the time itself. With this distinction in place, Perry can give an account of temporally specific thoughts which is consonant both with accounts of human action, and attitude reports involving indexicals. In the former case, the way we individuate psychological states in explaining and predicting action requires that we look at the mode of presentation of thoughts; so it is sense that is of interest. We might say that, for action, 'tain't what you think, it's the way that you think it. In the latter case, propositional attitude reports require the thought to be reported, not the way it was thought of. It's for this reason that the indexicals in speech reports are evaluated relative to the reporter's speech time, not the reportee's; all that matters in this case is what was thought (or said).

We do not need to decide whether Frege would have been convinced by Perry; as Burge (1979a:401) points out, Perry is interested in language, but Frege is more interested in the abstract structure of thought. For our purposes, the relevant question is: suppose Perry were right; does that mean that IQ would be wrong? The relevant answer is: no. This shouldn't be too surprising, of course, since IQ has at least two features in common with Perry. First, as we shall see in section 5.4, IQ has a Russellian aspect; secondly, IQ, as presented in this thesis, is committed to providing a sensitive treatment of temporal indexical expressions.

Now, IQ does make a distinction which can be taken to correspond to Perry's. Thus far, the distinction has not been explicitly remarked upon, but it is there nonetheless. We adverted to it in section 5.1.2, where it was stated that the difference between dates and indexicals disappears within the proposition, but is manifest in the means available for saying the same thing twice. The reason for this (in Russellian terms) is that at the propositional level, the only temporal object in the proposition is a bare time. When we report what was said, however, we must refer to that time in some particular way, either indexically or non-indexically. The temporally specific value-free propositions which we have put into IQ "contain" temporal intervals; the context-free indexical sentences which denote them "contain" ways of referring to those intervals, but not the intervals themselves.

The fact of the matter is that on the one hand, it is sentences of the language of IQ which contain tenses and indexicals, and which may be used to represent both sentences of English and senses of those sentences. On the other, it is the propositions denoted by sentences of IQ which are composed of functions from world-time indices to truth values, and

which may be used to represent both the thoughts expressed by English sentences, and the truth values denoted by them. For example, take the sentence (61), and its IQ representation (62).

- (61) George wrote the letter today
 (62) $PAST_{(v,t)}$ [ON today_t (George write the letter)]

For an utterance of (61) on i , the 27th of March 1986, we would say that where $i = g_c(t)$, the temporally specific value-free proposition expressed by the utterance is that named by (63).

- (63) that [$Gv't'PAST_{(v,t')}$ [ON today_t (George write the letter)]]
 (64) Earlier, George write the letter on 27/3/86

The subtle point is that (63) is the name of the value-free proposition, not the value-free proposition itself. The proposition is, of course, a function from world-time pairs to truth values; being temporally specific, it will only take to true pairs whose second member is the 27th of March 1986. Let us allow (64) to stand in for this proposition; it includes "Earlier" to represent the fact that (64) is a directed proposition, and the time to represent its temporal specificity. In a manner of speaking, (63) is the sense expressed by the utterance of (61), and the proposition represented by (64) is the thought expressed by that utterance. There will be many names in the language of IQ for the very same temporally specific value-free proposition. This corresponds to the fact that there are many ways of saying the same thing. The point about indexicals, then, is that for some given temporally specific value-free proposition, that proposition can be picked out using a particular indexical at only a limited range of times. For the proposition that a meeting starts at noon on the 28th of March 1986, that proposition can only be picked out using the indexical *now* in the sentence *The meeting starts now* at noon on the 28th of March, and at no other time³⁶.

Under section 5.3.2, we discussed Burge's views on the hierarchy; and noted that although Burge's argument is conducted in terms of Fregean senses, he explicitly stated that his argument for the hierarchy does not depend on a commitment to Fregean senses. As Burge (1979:273) says, if senses aren't thoughts, we could substitute standard syntactic names of sentences for the senses of sentences, and still have to answer the argument. Now, on the IQ construal of Perry, while (63) denotes the proposition for which (64) is standing in, it is also a standard name of (61), in the relevant sense that it can be derived algorithmically from it, by deparametrization, and the prefixing of the name-forming operator "that".

Thus, we could abandon all the talk about sense in both this and the previous section, and

our rejection of Burge's argument would still stand. For, with IQ names standing for senses, it should become clear that the hierarchy cannot be created through double oratio obliqua. The only way senses of senses could be created is by allowing names of names (of propositions). That is, we would get a hierarchy if we allowed expressions in the representational language of the form "that [that (A)]", where A is a context-free sentence. Indirect attitude reports don't involve such expressions: ignoring tenses, their representations are of the form "Say (X, that [Say, (Y, that [(A)])])". So the hierarchy won't arise from embedded speech or attitude reports. And indeed, even names of names could be excluded entirely by distinguishing names from sentences, and restricting the arguments of "that" to sentences. In this respect, IQ would render Perry's points even more simply. (63) is a standard name, and not a value-free proposition; the function for which (64) is standing in is a value-free proposition, not the name of a sentence of English. The two are intimately related, but cannot be identified.

So, Burge allows that senses may not be thoughts, but standard syntactic names. If they are thoughts (or value-free propositions), then the argument of section 5.3.2.3 allows IQ to defeat Burge. If they are names (expressions which denote value-free propositions), then they do not threaten a hierarchy either. If the latter course is chosen, then the sense of an abstract noun clause is not, after all, the value-free proposition expressed (and denoted) by the clause. It is simply the name of the clause. But if this is sense, it plays no essential role in the story of indirect reference. Thus, it would not be unreasonable to say that IQ not only manages to portray Fregean distinctions, but also manages to escape undesirable corollaries of those distinctions.

5.3.4 Command and Assertion

It has been established that IQ captures the essential difference between sense and reference, even though the direct/indirect distinction operates only at a sentential level. It's interesting to note that the intuitions lying beneath the treatment of commands and command reports in Chapter 4 are shared by Frege:

A subordinate clause with 'that' after 'command', 'ask', 'forbid', would appear in direct speech as an imperative. Such a sentence has no reference but only a sense. A command, a request, are indeed not thoughts, but they stand on the same level as thoughts. Hence in subordinate clauses depending on 'command', 'ask', etc, words have their indirect reference. The reference of such a clause is therefore not a truth-value but a command, a request, and so forth. [Frege 1892:167]

³⁶ For an illuminating discussion of this example from Perry (1979), see Butterfield (1986).

To say that an imperative has sense but no reference is to say that it denotes a value-free proposition rather than a value-specific proposition. Or, to put it in a rather different way, it expresses a proposition (in that proposition's value-free guise) rather than denoting that proposition (in its value-specific guise). It is in this sense that they are on the same level as thoughts. However, Frege seems to take this as the *reason* that words following *command* or *demand* have indirect reference. This seems like a rather shaky argument, which we would be ill-advised to pursue, even if IQ required the words themselves to act indirectly. It cannot be the reason, simply because on Frege's own analysis, words following *say* have their indirect reference, even though they originally appeared in assertions. Despite this disagreement, we can concur with Frege when he says that the reference of a subordinate command clause is not a truth value (value-specific proposition) but a command (value-free proposition).

As we have already seen, and as we shall emphasise in our discussion of Russell, the essential difference between the assertoric sentence and the abstract noun clause arises from the parametric nature of tense. Frege seemed to think while natural language lacked it, it would be desirable to have an explicit device of assertion.

Language has no special word or syllable to express assertion; assertive force is supplied by the form of the assertoric sentence, which is specially well-marked in the predicate. [Frege 1918-19:383]

It might be thought that Frege's assertion sign (Urtheilsstrich) plays the same role as tense. Perhaps it too takes us from a context-free sentence to a context-sensitive sentence; at a denotational level, it would take a value-free into a value-specific proposition. However, a closer examination of Frege's approach to the assertion sign shows that we cannot give it this interpretation:

[W]e want to assert that 5 is greater than 4 ... ' $5 > 4$ ' and ' $1 + 3 = 5$ ' just give us expressions for truth-values, without making any assertion ... We thus need a special sign in order to be able to assert something. To this end I make use of a vertical stroke at the left end of the horizontal, so that, eg, by writing ' $\vdash 2 + 3 = 5$ ' we assert that 2+3 equals 5. Thus here we are not just writing down a truth-value, as in ' $2 + 3 = 5$ ' but also at the same time saying that it is the True. [Frege 1891:149]

Frege takes the "unasserted" sentence to denote a truth-value, and the asserted one to denote the value and assert it to be the True. By contrast, and talking in terms of functions, we would take the unasserted (or tenseless) sentence to denote a function from indices to truth-values, and the asserted (or tensed) sentence to denote a (relativised) truth-value. Thus Frege's view of Urtheilsstrich most certainly does not coincide with our notion of tense. As far as he is concerned, indeed, ' $\vdash 2 + 3 = 5$ ' "does not designate anything; it asserts something" [Frege 1891:149]. IQ, on the other hand, would say that the asserted sentence does in fact denote; to be precise, it denotes a temporally relative truth-value.

In section 5.3, we have shown that in spite of certain superficial resemblances, Frege and IQ are separated by differences both of degree and substance. Neither of them is semantically innocent; but IQ is only guilty at a certain level. Both can distinguish sense from reference, but IQ's treatment of indirect speech reports doesn't require an intensional hierarchy. Both take commands to have no reference. Both distinguish asserted from unasserted sentences, but IQ takes both kinds to have denotation. In the next section, we shall consider the close connexions between the IQ framework and early Russellian semantics.

5.4 The Russellian Connexion

There is a certain irony in Kaplan's assertion that his temporally neutral propositions do not resemble traditional propositions. Kaplan's directly referential terms demand propositions which contain the objects to which they refer; in this respect at least, they closely resemble the propositions underlying Russell's (1903). Kaplan is keen to point out the connexion, and since we have already seen how to relate Kaplan's propositions to IQ's, it will prove very interesting to examine the role which IQ propositions can play in explicating Russell's view of propositions. Kaplan (1975) himself took on the task of explaining the Frege-Church ontology in terms of Russell's; we are now in a position to explain, in rough outline, an aspect of Russell's own ontology in terms of the IQ ontology. Obviously, the IQ framework as presented by Richards (1986) was elaborated in order to provide a Russellian semantics for temporal expressions, and it should not be surprising that resulting system, as elaborated in this thesis, should follow Russell closely. What is perhaps surprising is that IQ's innovations should throw so much light on Russell's own statements. In order to demonstrate just how good the match is, we shall quote extensively from Russell (1903) throughout this section.

Russell's views evolved over the years, and he gradually abandoned the view that the constituents of propositions are real-world objects. As Blair (1984) showed, one of the main reasons for Russell's changing his mind was the problem of explaining what it was that held a proposition together. In this section, we shall attempt to demonstrate that the "linguistic glue" is provided by tense alone. In order to do so, we shall first sketch the view of propositions adopted in Russell (1903), and then discuss his treatment of the dual role of verbs, and the intimate relation between those roles and assertion. We will then be in a position to explain the crucial role of tense in unifying Russell's propositions, and making them assertible.

5.4.1 Russell's 1903 Propositions

Russell said much on the subject of propositions; the classic statement of his original view, formed around 1900, is quoted below:

To have meaning, it seems to me, is a notion confusedly compounded of logical and psychological elements. Words all have meaning, in the simple sense that they are symbols which stand for something other than themselves. But a proposition, unless it happens to be linguistic, does not itself contain words: it contains the entities indicated by the words. Thus meaning, in the sense in which words have meaning, is irrelevant to logic ... [Mr Bradley's] confusion is largely due, I believe, to the notion that words occur in propositions, which in turn is due to the notion that propositions are essentially mental and are to be identified with cognitions. [Russell 1903:47]

So Russell claimed that propositions contained the real entities (or *terms*) denoted by words; as far as those terms are concerned, they include both things and concepts. These latter include both terms indicated by adjectives, and terms indicated by verbs; the concepts occurring inside propositions are just as real as the things: they do not differ "in respect of self-subsistence". Among them we would include all n-ary relations. Propositions, then, were made up of real world objects and properties. In reporting that verbs denoted concepts, we gloss over a very important distinction among verbs, and it is to this distinction that we now turn.

5.4.2 Assertion and Nominalisation

Russell notes the distinction in the following passage:

In regard to verbs ... there is a twofold grammatical form corresponding to a difference in merely external relations. There is the verb in the form which it has as verb (the various inflexions of this form may be left out of account), and there is the verbal noun, indicated by the infinitive or (in English) the present participle. The distinction is that between 'Felton killed Buckingham' and 'Killing no murder'. [Russell 1903:47-8]

By saying that the difference is "merely external", Russell means that the concept denoted by two forms of the one verb will be the same, and the proposition in which they appear could be the same. By a verbal noun, we are to understand the noun obtained from the verb by the process of nominalisation. In our subsequent discussion, we shall place more emphasis on nominalisation in general than on verbal nouns in particular. It is perhaps worth noting that, where the inflexions of the verb include inflexions for tense, their omission will turn out to have been very significant indeed.

Russell then concentrates on the logical consequences of nominalisation:

The question is: What logical difference is expressed by the difference of gram-

matical form? And it is plain that the difference must be one in external relations. But in regard to verbs, there is a further point. By transforming the verb, as it occurs in a proposition, into a verbal noun, the whole proposition can be turned into a single logical subject, no longer asserted, and no longer containing in itself truth or falsehood. But here too, there seems to be no possibility of maintaining that the logical subject which results is a different entity from the proposition. 'Caesar died' and 'the death of Caesar' will illustrate this point. [Russell 1903:48]

Now, if transforming the verb is just one method of nominalisation, then there should be other methods of nominalisation which might also turn the whole proposition into a logical subject. One such method is provided by IQ: "that" is a name forming operator, which names the proposition denoted by the context-free sentence within its scope³⁷. In terms of Russell's example, we can transform the value-free proposition expressed by *Caesar died* into a logical subject by applying *that* to it. We can express this name with the form *that Caesar died*. *That Caesar died* is a logical subject formed by nominalising the whole sentence, instead of just the verb. Obviously, *that Caesar died* differs from *Caesar's death* in that it still incorporates temporal information indicating what we have called the direction of the bare proposition. For this reason, we cannot think of the version of IQ presented here as giving anything like a definitive Russellian analysis of all types of nominalization. It remains the case, however, that this new name does provide an alternative, more specific, way of naming the death of Caesar.

If we ask: What is asserted in the proposition 'Caesar died'? the answer must be 'the death of Caesar is asserted'. In that case, it would seem, it is the death of Caesar which is true or false; and yet neither truth nor falsity belongs to a mere logical subject. The answer here seems to be that the death of Caesar has an external relation to truth or falsehood (as the case may be), whereas 'Caesar died' in some way or other contains its own truth or falsehood as an element. But if this is the correct analysis, it is difficult to see how 'Caesar died' differs from 'the truth of Caesar's death' in the case where it is true, or 'the falsehood of Caesar's death' in the other case. Yet it is quite plain that the latter, at any rate, is never equivalent to 'Caesar died'. [Russell 1903:48]

An even more transparent answer to the question "What is asserted in the proposition 'Caesar died'?" is "It is asserted that Caesar died". And that is just the answer one could volunteer, given the view that *that Caesar died* is the name of the original asserted proposition. Russell is right in stating that neither truth nor falsity is applicable to the logical subject. In our terms, the subject is just a value-free proposition, and therefore has no truth value of its own. Furthermore, it is now possible to see how *Caesar died* does indeed differ from a sentence concerning the truth value of the value-free proposition *that Caesar died*; an utterance of the former involves an assertion of the value-free proposition, the latter need not. Assertion is invoked through tense, and tense turns value-free propositions into value-specific propositions. As we show in Chapter 6, the semantic effect of IQ's

³⁷ See also Frege (1892:168): "The subordinate clause could be regarded as a noun, indeed one could say: as a proper name of that thought, that command, etc, which it represented in the context of the sentence struc-

tenses is to convert propositions that may go to true at many world-time indices to those that go to true at unique world-time indices. The difference between the two cases, then, is that while they both involve the value-free proposition named in (66), one involves the value-specific proposition denoted by (65), and the other does not.

- (65) $PAST_{(v,t)}$ (Caesar die)
 (66) that $[Gv, t' PAST_{(v,t')}]$ (Caesar die)]

For a particular utterance, (65) will have a truth value at the index of utterance; (66) will not. It should now be becoming clear just how well our value-free and value-specific propositions capture what Russell is trying to say about assertion and nominalisation. The passage below is particularly striking:

There appears to be an ultimate notion of assertion, given by the verb, which is lost as soon as we substitute a verbal noun, and is lost when the proposition in question is made the subject of some other proposition. This does not depend on grammatical form; for if I say "Caesar died" is a proposition', I do not assert that Caesar did die, and an element which is present in 'Caesar died' has disappeared. [Russell 1903:48]

The ultimate notion of assertion, we would say, is indeed given by the verb; more specifically, it is given by the tense of the verb. When we replace a proposition denoted by a tensed sentence by the proposition denoted by the deparametrized analogue of the original sentence, the semantic function of tense is lost. This is just what happens when we make a proposition the subject of another proposition. Indeed, it is just what happens, whenever we try to express one proposition as part of another; this is what happens in indirect speech reports. The element that is missing in the cases where propositions go unasserted is just tense. Otherwise the proposition is nearly the same: it is the value-free version. The similarity helps to explain some of Russell's other comments on nominalisation:

Every proposition, by turning its verb into a verbal noun, can be changed into a single logical subject, of a kind which I shall call in future a propositional concept. [Russell 1903:52]

and

The propositional concept seems, in fact, to be nothing other than the proposition itself, the difference being merely the psychological one that we do not assert the proposition in one case, and do assert it in the other. [Russell 1903:526-7]

On our account, the difference is not merely psychological: it can be seen in the differing semantic representations which must be given for the proposition and the propositional concept. We have now shown that the distinctions introduced by IQ allow us to express the ultimate notion of assertion, which Russell found so "exceedingly hard to define". With this in hand, it is possible to isolate the glue that sticks propositions together.

ture."

5.4.3 The Unity of the Proposition

Our current analysis again comes close to Russell when he says:

The twofold nature of the verb, as actual verb and as verbal noun, may be expressed, if all verbs are held to be relations, as the difference between a relation in itself and a relation actually relating. Consider, for example, the proposition 'A differs from B'. The constituents of this proposition, if we analyze it, appear to be only A, difference, B. Yet these constituents, thus placed side by side, do not reconstitute the proposition. The difference which occurs in the proposition actually relates A and B, whereas the difference after analysis is a notion which has no connection with A and B. [Russell 1903:49]

The constituents do not reconstitute the value-specific proposition, since Russell has missed out the vital ingredient: tense. As they stand, the constituents would be sufficient to build a bare value-free proposition; but without a tense, to invoke evaluation, there is no way of simulating the original value-specific proposition. Before analysis, we had tense, and could utter the sentence, and say something about the relation of A to B. After Russell's analysis, we have lost tense, and we cannot regard the pieces left over as allowing us to make an assertion about A and B. What's missing is tense, and we do not need to follow Russell up his suggested garden path:

It may be said that we ought, in the analysis, mention the relations which difference has to A and B, relations which are expressed by 'is' and 'from' when we say 'A is different from B'. These relations consist in the fact that A is referent and B relatum with respect to difference. But 'A, referent, difference, relatum, B' is still merely a list of terms, not a proposition. [Russell 1903:49]

A list of terms which does not include an appropriate tense may make up a proposition (if, following Frege, the list includes the correct mix of concepts and objects), but if it does, it will only be a value-free proposition, unasserted. What Russell wants is his pre-analytic value-specific proposition, and only due regard to tense (whose inflexions were ignored) will restore it. To paraphrase Russell, we have tightened up the loose talk about the copula. And in the process, we have restored the unity he wanted:

A proposition ... is essentially a unity, and when analysis has destroyed the unity, no enumeration of constituents will restore the proposition. The verb, when used as a verb, embodies the unity of the proposition, and is thus distinguishable from the verb considered as a term, though I do not know how to give a clear account of the precise nature of the distinction. [Russell 1903:49-50]

The precise nature of the distinction lies in tense: in contexts where the verb is a verb, the proposition has tense; in contexts where the verb is a term, the proposition has no tense. The unity of the proposition is provided by the verb; more precisely, it is provided by the tense of the verb.

Examining the original Russell in the light of the system inspired by him has allowed us to improve our understanding of Russell (1903). Moreover, it throws into sharp perspective two aspects of IQ. First, we can see how "Russellian" IQ really is; secondly, we can see

what IQ gains over Russell. With the distinction between value-freedom and value-specificity introduced by the privileged role of tense, we can capture the generalisations Russell found so hard to put into words. There is another advantage in this exegesis: it has shown that only a small elaboration of the Russell picture is required to portray the unity of propositions. Russell was looking for an extra ingredient, which wasn't in the world, which would help stick propositions together. If we're right, we have found the non-world glue in the medium of tense.

5.5 Conclusions

The indexical enterprise has allowed us to properly segregate the semantic roles of tense and indexicals. In Chapters 3 and 4, we showed that their representations are distinct but intimately related. In this chapter, we have seen how tense and indexicals cause divergence at the denotational level, and how they crucially differ on the issue of temporal specificity. There is a spectrum of value-free propositions ranging from the bare, temporally neutral proposition to the directed, temporally specified proposition; at the end of this spectrum lies the value-specific proposition. It is particularly notable that no single one of IQ's varieties of proposition captures all the intuitive properties of propositions (for instance: the proposition is that which may be asserted, or thought, or is the bearer of truth). Instead, there is a division of semantic labour among IQ's propositions. This is, perhaps, right; a unitary "intuitive" notion of proposition is notoriously elusive.

With our entities in place, it is fascinating to compare the semantic picture with those of Kaplan, Frege, and especially Russell. We thought of tense as Russell's assertive glue; in our function picture, it's still the thing that creates assertion by creating value-specificity. Overall, the comparison has allowed us to locate IQ with respect to these established positions; what has emerged is that IQ is fairly Fregean, but really Russellian. What's more, it is also striking how important tense and indexicals are to an articulated theory of propositions; giving these constructions their proper place has allowed us to express all the old distinctions, and a number of new ones. These last have turned out to be crucial.

In this way, we have achieved the second aim of the thesis; having derived a theory of indexicals and embedded it within an indexical interval semantics, we have now placed the final product in perspective. This chapter has established a point of view with respect to concerns in philosophical logic. The final aim of the thesis is to fix a perspective at a formal level; it is to this task that we now turn.

Chapter 6: A Formal Comparison of LD* and IQ*

In Chapters 3 and 4, we examined the representations a particular truth-conditional semantic framework would give to temporal indexicals, bound and unbound. In Chapter 5, we went on to compare the propositions which were the denotations assigned to those representations with the denotational entities invoked in other approaches to natural language semantics. In this chapter, we set out to achieve the third aim of the thesis; thus we pursue a rather more formal enterprise, specifying the syntax and semantics of a fragment of the IQ system we have been discussing. This will allow us to compare IQ with David Kaplan's LD (Kaplan (1977;1979)); the comparison will serve a dual purpose. First, it will allow us to extend and refine the discussion embarked upon in section 2 of Chapter 5; in particular, we will uncover a vital aspect of IQ's propositions, whereby they can be true at single world-time indices. Secondly, it will allow us to specify precisely where IQ stands in relation to a classic formal treatment of demonstratives and indexicals. For the purposes of comparison, we won't be discussing either IQ or LD themselves; instead, we will compare and contrast variants on the systems, which we will call IQ* and LD*, respectively.

6.1 Overview of the Differences between LD* and IQ*

Before presenting the formal systems, it's useful to establish the major points of difference and similarity between them. In this section, therefore, we'll consider briefly the syntax and semantics of the systems, and stake out a general view of the comparative approaches to tenses and indexicals.

6.1.1 Semantics

The first major point to note is that, in what follows, we are taking the two systems to share the same models. Both systems require metalinguistic reference to not only the index of utterance, but also the index of evaluation. As a result, an element of the model is taken to be a pair, composed of a context-index and a circumstance-index. Since LD* is a temporal fragment of Kaplan's LD, all the apparatus which he had to include in order to deal with locational and personal indexicals has been jettisoned. Amongst other things, this means that contexts can be rendered as world-time pairs rather than as n-tuples, since these

are the only aspects of context which are relevant to the operators of the LD* object-language. On this basis, both LD* and IQ* are varieties of double-indexing systems, following Kamp (1971). This doesn't mean that context is conflated with circumstance, since they are represented as distinguished pairs, but it does mean that they are both pairs of worlds and times.

A second point is that IQ* uses integers for times, in order to facilitate the comparison with LD*. This means that questions cannot be raised concerning the homogeneity of temporal intervals, or the effects of temporal quantifiers over intervals. Given the indexical operators in each of the object-languages, we may wish to think of the integral times as complete "days". This difference between IQ and IQ* is related to a move back from partial functions to total functions. As we mentioned in Chapter 3, no essential use is made of partiality in the thesis; so we lose nothing in this change.

These moves considerably simplify the task of comparing the representational power of the systems; we need only consider the syntactic translation functions from LD* to IQ* and back again, since the semantic transformation is the identity function, either way. It should be noted, however, that the systems do differ slightly in what they take to parameters. Following on from the preceding chapters, we assume that in IQ*, there is a contextual function which takes parameters (elements of the object-language) to values. Here, the function g_c is a two-place function on contexts and a restricted set of linguistic expressions, returning elements of the model. But for LD*, there will be two contextual functions, both taking contexts to elements of the model. It is these functions that Kaplan calls "parameters". In fact, each function will be a one-place function on contexts, returning, in the first case, worlds, and in the second case, times. It should be clear that the IQ* function's extra place (for the linguistic parameters) allows a simpler expression of Kaplan's "parameters"; and also allows for the distinction between parametric and non-parametric occurrences of the same expression. Notice that in evaluating sentences in contexts, we exclude the possibility that g_c takes an inappropriate context as input; this simplifies matters a lot.

Significantly, the parametric nature of the indexicals and tenses of IQ* ensures that a tensed wff of IQ* will be true, relative to a context, at only one context-circumstance pair. In LD*, however, it will tend to be the case that tensed wffs are true, relative to a context, at many context-circumstance pairs. This difference leads to major divergence in the satisfiability conditions of wffs in the two systems, which can only be resolved by adding new expressions to the object-language of LD*. These new expressions involve singular reference to times and worlds, and are required in order to simulate the parametric nature

of tense and indexicals in IQ*.

6.1.2 Syntax: Tense and Indexicals

Turning to syntax, the most important differences concern the treatment of tense and indexicals, and in the well-formedness conditions associated with them. Firstly, in IQ*, but not LD*, tenses are rendered as indexical expressions; the presence of parameters within their form guarantees their indexicality. The effects of this difference can be seen in the way that LD* allows the truth of a tensed wff to depend on the truth of the untensed wff relative to a time which need have no connexion to context at all; IQ*, by contrast, requires more from this time, namely, that it be related in a relevant way to the time of the context.

Secondly, there are more conditions on the well-formedness of formulae in IQ*. These conditions are placed in order to restrict tense iteration, in accord with the version of IQ presented in Richards (1986) and the preceding chapters. However, we will note that these restrictions could be removed, and the burden of restriction shifted to the semantics, if it were deemed desirable or necessary.

6.2 Formulation of LD*

The following section outlines a version of David Kaplan's Logic of Demonstratives which can be directly compared with the formulation of IQ given in the next section. Let's call this version of LD "LD*". LD* contains four tense operators, including a *day before* and a *day after* operator, and it has four indexical operators, including an *actually* operator.

6.2.1 Syntax

Primitive Symbols for Single-Sorted Predicate Logic

- 0 Punctuation (,)
- 1 Infinite set of variables V
- 2 Infinite set of n -place predicates, for all natural numbers n .
- 3 An infinite set of n -place functors, for all natural numbers n .
- 4 Sentential connectives: $\&$, \vee , $-$, \rightarrow , \leftrightarrow
- 5 Quantifiers: \forall, \exists
- 6 A definite description operator: the
- 7 Identity: $=$

Primitive Symbols for Tense Logic

8 Tense Operators: P, F, K, L

Primitive Symbols for Logic of Demonstratives

9 1-Place Sentential Operators: A, N, Y, T

Additional Primitive Symbols for LD/IQ* Equivalence*

- 10 A temporal constant: S_time
- 11 A modal constant: S_world
- 12 An infinite set of temporal variables: V_T
- 13 An infinite set of modal variables: V_V

*Well-formed expressions of LD**

- 1 If $\alpha \in (V \cup V_T \cup V_V)$, then α is a term.
- 2 If R is an n-place predicate, and $\alpha_1, \dots, \alpha_n$ are terms, then $R\alpha_1 \dots \alpha_n$ is a wff.
- 3 If Q is an n-place functor, and $\alpha_1, \dots, \alpha_n$ are terms, then $Q\alpha_1 \dots \alpha_n$ is a term.
- 4 If ϕ, ψ are wffs, then $\phi \& \psi, \phi \vee \psi, \neg\phi, \phi \rightarrow \psi, \phi \leftrightarrow \psi$ are wffs.
- 5 If ϕ is a wff, and $\alpha \in V$, then $\forall\alpha\phi, \exists\alpha\phi$ are wffs.
- 6 If ϕ is a wff, then if $\alpha \in V$, then the $\alpha\phi$ is a term.
- 7 If α, β are terms, then $\alpha=\beta$ is a wff.
- 8 If ϕ is a wff, then $P\phi, F\phi, K\phi, L\phi$ are wffs.
- 9 If ϕ is a wff, then $A\phi, N\phi, Y\phi, T\phi$ are wffs.

*Models for LD**

- 1 Definition: M is an LD*-structure iff there are C, W, I, D and J such that:
- 2 C is a non-empty set of pairs, the set of permissable contexts.
- 3 If $c \in C$, then $c=\langle w, i \rangle$, such that $w \in W, i \in I$, and w and i are the world and time of the context.
- 4 W is a nonempty set (the set of worlds).
- 5 I is the set of integers (the set of times, common to all worlds).
- 6 D is a nonempty set (the set of individuals).
- 7 J is a function that assigns to each predicate and functor an appropriate intension as follows:
 - 7.1 If R is an n-place predicate, J_R is a function such that for each $w' \in W$ and $i' \in I$, $J_R(w', i') \subseteq D_n$.
 - 7.2 If Q is an n-place functor, J_Q is a function such that for each $w' \in W$ and $i' \in I$, $J_Q(w', i') \in (D \cup \{+\})^{D_n}$.

6.2.2 Truth

Truth and Denotation in a Context

We write: $\llbracket \phi \rrbracket^{<<w,i>,<w',i'>>,f,M} = T$

for: ϕ when taken in context $<w,i>$ (under assignment f and structure M) is true with respect to world w' and time i' .

In the style of Kaplan, this could also be written: $\models_{<w,i>,<w',i'>,f}^M \phi$.

In general, we write: $\llbracket \alpha \rrbracket^{<<w,i>,<w',i'>>,f,M}$

for: the denotation of α in context $<w,i>$ (under f and M), with respect to world w' and time i' .

Assume: $M = \langle C, W, I, D, J \rangle$

Definition: f is an assignment with respect to M iff $f \in D^V$

Definition: $f_x^\alpha = (f - \{ \langle \alpha, f(\alpha) \rangle \}) \cup \{ \langle \alpha, x \rangle \}$

NB: There will be a pair of “parameters” W_p, T_p which constitute functions from contexts to elements of W and I respectively. Reference to these “parameters” is suppressed in what follows, but their effects can be traced in the truth conditions of those operators which are indexical in nature.

Assume: $<w,i> \in C$, f is an assignment, $w, w' \in W$ and $i, i' \in I$.

6.2.3 Semantics for LD*

- 1 If $\alpha \in V$, then $\llbracket \alpha \rrbracket^{<<w,i>,<w',i'>>,f} = f(\alpha)$.
- 2 $\llbracket R\alpha_1 \dots \alpha_n \rrbracket^{<<w,i>,<w',i'>>,f} = T$
iff
 $\langle \llbracket \alpha_1 \rrbracket^{<<w,i>,<w',i'>>,f} \dots \llbracket \alpha_n \rrbracket^{<<w,i>,<w',i'>>,f} \rangle \in J_R(w'i')$.
- 3 $\llbracket Q\alpha_1 \dots \alpha_n \rrbracket^{<<w,i>,<w',i'>>,f} = \chi$, where
 $\chi = J_Q(w'i')(\langle \llbracket \alpha_1 \rrbracket^{<<w,i>,<w',i'>>,f} \dots \llbracket \alpha_n \rrbracket^{<<w,i>,<w',i'>>,f} \rangle)$,
if none of $\llbracket \alpha_m \rrbracket^{<<w,i>,<w',i'>>,f} = \dagger$, and $\chi = \dagger$ otherwise.
- 4
 - 4.1 $\llbracket \phi \ \& \ \psi \rrbracket^{<<w,i>,<w',i'>>,f} = T$
iff
 $\llbracket \phi \rrbracket^{<<w,i>,<w',i'>>,f} = T$ and $\llbracket \psi \rrbracket^{<<w,i>,<w',i'>>,f} = T$.
 - 4.2 $\llbracket \phi \vee \psi \rrbracket^{<<w,i>,<w',i'>>,f} = T$

- iff
 $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$ or $\llbracket \psi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$.
- 4.3 $\llbracket \neg \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$
iff
it's not the case that $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$.
- 4.4 $\llbracket \phi \rightarrow \psi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$
iff
it is not the case that $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$ and $\llbracket \psi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = F$.
- 4.5 $\llbracket \phi \leftrightarrow \psi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$
iff
 $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$ is the same as $\llbracket \psi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$.
- 5 5.1 If $\alpha \in V$, then $\llbracket \forall \alpha \phi \rrbracket = T$
iff
for all $x \in D$, $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>}^{\alpha_x} = T$.
- 5.2 If $\alpha \in V$, then $\llbracket \exists \alpha \phi \rrbracket = T$
iff
for some $x \in D$, $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>}^{\alpha_x} = T$.
- 6 If $\alpha \in V$, then $\llbracket \text{the } \alpha \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = \text{the unique } x \in D$
such that
 $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>}^{\alpha_x} = T$, if there is one, and \uparrow otherwise.
- 7 $\llbracket \alpha = \beta \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$
iff
 $\llbracket a \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = \llbracket b \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>}$.
- 8 8.1 $\llbracket P\phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$
iff
 $\exists i'' < i'$ such that $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i'' \rangle>} = T$.
- 8.2 $\llbracket F\phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$
iff
 $\exists i'' > i'$ such that $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i'' \rangle>} = T$.
- 8.3 $\llbracket K\phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$ iff $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i'-1 \rangle>} = T$.
- 8.4 $\llbracket L\phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$ iff $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i'+1 \rangle>} = T$.
- 9 9.1 $\llbracket A\phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$ iff $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$.
- 9.2 $\llbracket N\phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$ iff $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$.
- 9.3 $\llbracket Y\phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$ iff $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i'-1 \rangle>} = T$.
- 9.4 $\llbracket T\phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$ iff $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i'+1 \rangle>} = T$.
- 10 $\llbracket S_{\text{time}} \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = i$
- 11 $\llbracket S_{\text{world}} \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = w$
- 12 If $t' \in V_T$, then $\llbracket t' \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = i'$
- 13 If $v' \in V_V$, then $\llbracket v' \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = w'$

6.2.4 Remarks

LD* is, essentially, a faithful temporal fragment of Kaplan's LD. Interestingly enough, the new modal and temporal terms S_{world} and S_{time} have treatments very much like *I* and *Here* in Kaplan's original LD: they're constants. They are introduced in order to allow equivalence between LD* and IQ*. Without them, as we shall see in section 5, LD* cannot represent the distinctions representable in IQ*. Following Kaplan, the symbol \dagger represents an alien entity, not in the domain D.

6.3 Formulation of IQ*

The following section outlines a version of IQ designed to be directly compared with the formulation of LD. Let's call this version of IQ "IQ*". IQ* has three tense operators, three indexical operators, and an *actually* operator whose truth-conditions are the same as those of Kaplan's operator.

6.3.1 Syntax

Primitive Symbols for Single-Sorted Predicate Logic

- 0 Punctuation (.)
- 1 Infinite set of variables V
- 2 Infinite set of n -place predicates, for each natural number n .
- 3 An infinite set of n -place functors, for each natural number n .
- 4 Sentential connectives: $\&$, \vee , \neg , \rightarrow , \leftrightarrow
- 5 Quantifiers: \forall, \exists
- 6 A definite description operator: *the*
- 7 Identity: $=$

Primitive Symbols for Indexical/Tense Logic

- 8 1-Place Tense Operators: $\text{PRES}_{(v,t)}$, $\text{PAST}_{(v,t)}$, $\text{FUT}_{(v,t)}$
- 9 1-Place Indexical Operators: N_t , Y_t , T_t
- 10 1-Place Intensional Operator: A
- 11 Deparametrizing Operator: G
- 12 Infinite set of temporal variables: V_T
- 13 Infinite set of modal variables: V_V

Well-formed expressions of IQ*

- 1 If $\alpha \in V$, then α is a term
- 2 If R is an n -place predicate, and $\alpha_1, \dots, \alpha_n$ are terms, then $R\alpha_1 \dots \alpha_n$ is a wff.
- 3 If Q is an n -place functor, and $\alpha_1, \dots, \alpha_n$ are terms, then $Q\alpha_1 \dots \alpha_n$ is a term.
- 4 If ϕ, ψ are wffs, then $\phi \& \psi, \phi \vee \psi, \neg\phi, \phi \rightarrow \psi, \phi \leftrightarrow \psi$ are wffs.
- 5 If ϕ is a wff, and $\alpha \in V$, then $\forall\alpha\phi, \exists\alpha\phi$ are wffs.
- 6 If ϕ is a wff, then if $\alpha \in V$, then the $\alpha \phi$ is a term.
- 7 If α, β are terms, then $\alpha=\beta$ is a wff.
- 8 If ϕ is not a wff of the form $B_{(v,t)}\psi$ ($B \in \{\text{PRES, PAST, FUT}\}$), then $B_{(v,t)}\phi$ is a wff.
- 9 If ϕ is a wff, then $N_t\phi, Y_t\phi, T_t\phi$ are wffs.
- 10 If ϕ is a wff, then $A\phi$ is a wff.
- 11 If ϕ is a wff, $v' \in V_V$, and $t' \in V_T$, then $Gv'\phi$ and $Gt'\phi$ are wffs.
- 12 If ϕ is a wff, $v' \in (V_V \cup C_V)$, $t' \in (V_T \cup C_T)$, and $B \in \{\text{PRES, PAST, FUT}\}$, then $B_{(v',t')}\phi$ is a wff.

Models for IQ*

- 1 Definition: M is an IQ*-structure iff there are C, W, I, D and J such that:
- 2 C is a non-empty set of pairs, the set of permissible contexts.
- 3 If $c \in C$, then $c = \langle w, i \rangle$, such that $w \in W, i \in I$, and w and i are the world and time of the context.
- 4 W is a nonempty set (the set of worlds).
- 5 I is the set of integers (the set of times, common to all worlds).
- 6 D is a nonempty set (the set of individuals).
- 7 J is a function that assigns to each predicate and functor an appropriate intension as follows:
 - 7.1 If R is an n -place predicate, J_R is a function such that for each $w' \in W$ and $i' \in I$, $J_R(w', i') \subseteq D_n$.
 - 7.2 If Q is an n -place functor, J_Q is a function such that for each $w' \in W$ and $i' \in I$, $J_Q(w', i') \in (D \cup \{\dagger\})^{D_n}$.
- 8 Where $u^* \in (V_V \cup C_V \cup V_T \cup C_T)$, $u \in (W \cup I)$

6.3.2 Truth

Truth and Denotation in a Context

As in LD*, we write: $\llbracket \phi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle, f, M} = T$

for: ϕ when taken in context $\langle w, i \rangle$ (under assignment f and structure M) is true with respect to world w' and time i' .

In general, we write: $\llbracket \alpha \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle, f, M}$

for: the denotation of α in context $\langle w, i \rangle$ (under f and M), with respect to world w' and time i' .

We write: $\phi_s^{u^*}$

for: the result of substituting u^* for every instance of s in ϕ .

We write: $Gv't'\phi$ for: $Gv'Gt'\phi$

Assume: $M = \langle C, W, I, D, J \rangle$

Definition: f is an assignment with respect to M iff $f \in D^V$

Definition: $f_x^\alpha = (f \sim \{\langle \alpha, f(\alpha) \rangle\}) \cup \{\langle \alpha, x \rangle\}$

Definition: g_c is an assignment of values to contextual parameters, with respect to the model M and the context $\langle w, i \rangle$ (rendered as subscripted c),
iff

g_c is a 2-place function, from contexts c and expressions n , to elements of the model, such that:

$$g_c(n) = \begin{array}{ll} w, & \text{if } n=v \\ i, & \text{if } n=t \\ u, & \text{if } n=u^* \\ \dagger, & \text{otherwise} \end{array}$$

Assume: $\langle w, i \rangle \in C$, f is an assignment, g_c is a contextual function assigning values to parameters, $w, w' \in W$ and $i, i' \in I$. As with LD^* , reference to g_c will be suppressed, except where it is relevant.

6.3.3 Semantics for IQ^*

- 1 If $\alpha \in V$, then $\llbracket \alpha \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = f(\alpha)$.
- 2 $\llbracket R\alpha_1 \dots \alpha_n \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = T$
iff
 $\langle \llbracket \alpha_1 \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} \dots \llbracket \alpha_n \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} \rangle \in J_R(w' i')$.
- 3 $\llbracket Q\alpha_1 \dots \alpha_n \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = \chi$, where
 $\chi = J_Q(w' i') (\langle \llbracket \alpha_1 \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} \dots \llbracket \alpha_n \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} \rangle)$,
if none of $\llbracket \alpha_m \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = \dagger$, and $\chi = \dagger$ otherwise.
- 4
 - 4.1 $\llbracket \phi \ \& \ \psi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = T$
iff
 $\llbracket \phi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = T$ and $\llbracket \psi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = T$.
 - 4.2 $\llbracket \phi \vee \psi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = T$
iff
 $\llbracket \phi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = T$ or $\llbracket \psi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = T$.
 - 4.3 $\llbracket \neg \phi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = T$
iff
it's not the case that $\llbracket \phi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f}$.
 - 4.4 $\llbracket \phi \rightarrow \psi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = T$
iff
it is not the case that $\llbracket \phi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = T$ and $\llbracket \psi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = F$.
 - 4.5 $\llbracket \phi \leftrightarrow \psi \rrbracket^{\langle \langle w, i \rangle, \langle w', i' \rangle \rangle f} = T$
iff

- $[\phi]^{<<w,i>,<w',i'>>f}$ is the same as $[\psi]^{<<w,i>,<w',i'>>f}$.
- 5 5.1 If $\alpha \in V$, then $[\forall\alpha\phi] = T$
iff
for all $x \in D$, $[\phi]^{<<w,i>,<w',i'>>f_x^\alpha} = T$.
- 5.2 If $\alpha \in V$, then $[\exists\alpha\phi] = T$
iff
for some $x \in D$, $[\phi]^{<<w,i>,<w',i'>>f_x^\alpha} = T$.
- 6 If $\alpha \in V$, then $[\text{the } \alpha \phi]^{<<w,i>,<w',i'>>f} = \text{the unique } x \in D$
such that
 $[\phi]^{<<w,i>,<w',i'>>f_x^\alpha} = T$, if there is one, and \uparrow otherwise.
- 7 $[\alpha=\beta]^{<<w,i>,<w',i'>>f} = T$
iff
 $[\alpha]^{<<w,i>,<w',i'>>f} = [\beta]^{<<w,i>,<w',i'>>f}$.
- 8 8.1 $[\text{PRES}_{(v,t)}\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
iff
 $g_c(v)=w'$ and $g_c(t)=i'$ and $[\phi]^{<<w,i>,<w',i'>>f,g_c} = T$.
- 8.2 $[\text{PAST}_{(v,t)}\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
iff
 $g_c(v)=w'$ and $g_c(t)=i'$ and $\exists i'' < i'$
such that
 $[\phi]^{<<w,i>,<w',i''>>f,g_c} = T$.
- 8.3 $[\text{FUT}_{(v,t)}\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
iff
 $g_c(v)=w'$ and $g_c(t)=i'$ and $\exists i'' > i'$
such that
 $[\phi]^{<<w,i>,<w',i''>>f,g_c} = T$.
- 9 9.1 $[\text{N}_t\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
iff
 $g_c(t)=i'$ and $[\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
- 9.2 $[\text{Y}_t\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
iff
 $g_c(t)=i'+1$ and $[\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
- 9.3 $[\text{T}_t\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
iff
 $g_c(t)=i'-1$ and $[\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
- 10 $[\text{A}\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
iff
 $[\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
- 11 11.1 $[\text{Gv}'\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
iff
 $[\phi_{v'}^{w'*}]^{<<w,i>,<w',i'>>f,g_c} = T$
- 11.2 $[\text{Gt}'\phi]^{<<w,i>,<w',i'>>f,g_c} = T$
iff
 $[\phi_{t'}^{i'*}]^{<<w,i>,<w',i'>>f,g_c} = T$

6.3.4 Remarks

It is interesting to note that condition 8 in the well-formedness clauses in section 3.1 could be altered so that whatever the form of ϕ , $B_{(v,t)}\phi$ was well-formed. This would mean that for $B_1, B_2 \in \{\text{PRES, PAST, FUT}\}$, a wff ψ of the form $B_{1(v,t)}B_{2(v,t)}\phi$ would be well-formed. This needn't necessarily mean a radical departure from the version of IQ presented in the preceding chapters, for where $B_1 \neq \text{PRES}$, ψ would be unsatisfiable (cf section 4.2). But in order to remain faithful to the context-sensitive/context-free distinction, condition 8 will be left in its current form.

Another important point is that the operator A introduced as a primitive symbol for indexical/tense logic, and given its semantics in clause 10 above, is identical to Kaplan's operator. It is treated separately from IQ*'s indexical operators because it does not have the same type of semantic effect: since it isn't parametric, it doesn't place conditions on the circumstance indices in the way that IQ*'s indexicals do. It is a Kaplan indexical; but that does not make it a proper IQ* indexical. We examine in more detail the difference between the semantics of indexicals in the two systems in section 6.6 below. The significant point here is that the operator in IQ* does not have the effects of the evil "actual_v" indexical discussed in Chapter 5, section 1.4. It isn't on a par with IQ*'s indexicals, and so does not cause the problems discussed in Chapter 5; it does, however, make translation between LD* and IQ* truth-condition preserving.

6.4 Properties of the Systems

In comparing two systems, we want to find out whether it's possible to construct the functions σ (sigma) and τ (tau). σ provides a syntactic translation of expressions of one theory into expressions of the other, preserving theoremhood, or validity. τ provides a semantic transformation of one model into the other.

$$\begin{array}{llll} (1) & M & & \tau(M) \\ (2) & \llbracket \phi \rrbracket = \text{True} & \text{iff} & \llbracket \sigma(\phi) \rrbracket = \text{True} \end{array}$$

Now, in designing the models for LD* and IQ*, a conscious decision was taken to ensure that the similarity in LD*-worlds and IQ*-worlds was portrayed by their respective model structures. As a result, τ is simply the identity function. LD*-worlds are IQ*-worlds. With regard to the syntax, it's clear that the presence of parameters in the object-language operators of IQ* requires σ to do rather more work than τ . In section 4.1, we shall exhibit a translation theorem which would guide the validity-preserving syntactic translation from LD* into IQ*; in the subsequent sections, we'll look at the way IQ* represents Kaplan's

definitions for validity and necessary truth. Looking slightly further ahead, section 5 will examine reasons for thinking that while IQ* can translate LD*, the converse is not true. Section 6 will then propose the extensions to LD* that are required to enable it to translate expressions of IQ*.

6.4.1 Translation Theorem

It is proposed that any translation scheme from LD* into IQ* should respect the following theorem.

$[\phi]^{<<w,i>, <w',i'>>}$ is true-in-LD*
iff
 $[\text{Gv't'PRES}_{(v',t')}(\sigma(\phi))]^{<<w,i>, <w',i'>>}$ is true-in-IQ*

A wff of LD*, which may be true at more than one context-circumstance pair, must be translated by a wff of IQ* which can also be true at more than pair. Thus, a deparametrized wff is appropriate. In general, if the formula ϕ is tensed (ie of the form $P\psi$ or $F\psi$), the IQ* translation will contain a deparametrized tense as the initial operator ³⁸. The translation σ from LD* to IQ* does at least the following:

$$(3) \quad \begin{array}{lll} N & \longrightarrow & N_t \\ Y & \longrightarrow & Y_t \\ P & \longrightarrow & \text{Gv't'PAST}_{(v',t')} \\ F & \longrightarrow & \text{Gv't'FUT}_{(v',t')} \\ - & \longrightarrow & \text{Gv't'PRES}_{(v',t')} \end{array}$$

We'll see in more detail in section 7 the full scheme for translation. We do not prove there that the translation functions are consistent with the theorem. But a proof would be relatively simple, proceeding by induction on the complexity of formulae. For the moment it should suffice to note that we are effectively in the position to carry out top-down translation from LD* to IQ*. For instance, omitting subscripts for brevity,

$$(4) \quad P\phi \ \& \ F\psi \longrightarrow \text{GPRES}(\text{GPAST}(\text{GPRES} \ \phi) \ \& \ \text{GFUT}(\text{GPRES} \ \psi))$$

6.4.2 Validity and Satisfiability

ϕ is valid-in-LD* iff $\forall wi \ [\phi]^{<<w,i>, <w,i>>} = \text{True}$
iff
 $\forall wi \ [\text{Gv't'PRES}_{(v',t')}(\sigma(\phi))]^{<<w,i>, <w,i>>} = \text{True}$

Validity in LD* is just as Kaplan defined it. By equivalence of truth-conditions, the untensed IQ* expression will be true at the index $\langle\langle w,i\rangle,\langle w,i\rangle\rangle$ just in case its tensed analogue is true at that index. That is:

$$\begin{aligned} & \llbracket \text{Gv't'PRES}_{(v',t')} (\sigma(\phi)) \rrbracket^{\langle\langle w,i\rangle,\langle w,i\rangle\rangle} = \text{True} \\ \text{iff} \\ & \llbracket \text{PRES}_{(v,t)} (\sigma(\phi)) \rrbracket^{\langle\langle w,i\rangle,\langle w,i\rangle\rangle} = \text{True} \end{aligned}$$

The question of validity may be said to arise when we want to know, for some sentence, whether it will always be true whenever it is uttered. This last equivalence shows why, when posed in IQ*, the question of validity seems to arise for tensed sentences of the theory.

$$\begin{aligned} \phi \text{ is satisfiable-in-LD*} & \text{ iff } \exists wi \llbracket \phi \rrbracket^{\langle\langle w,i\rangle,\langle w,i\rangle\rangle} = \text{True} \\ \text{iff} \\ \exists wi & \llbracket \text{Gv't'PRES}_{(v',t')} (\sigma(\phi)) \rrbracket^{\langle\langle w,i\rangle,\langle w,i\rangle\rangle} = \text{True} \end{aligned}$$

This result is straightforward: a wff is satisfiable iff there is at least one context at which it evaluates to true. This result will be of use in section 5.

6.4.3 Necessity

$$\begin{aligned} \phi \text{ is necessary-in-LD*} & \text{ iff } \forall wiw'i' \llbracket \phi \rrbracket^{\langle\langle w,i\rangle,\langle w',i'\rangle\rangle} = \text{True} \\ \text{iff} \\ \forall wiw'i' & \llbracket \text{Gv't'PRES}_{(v',t')} (\sigma(\phi)) \rrbracket^{\langle\langle w,i\rangle,\langle w',i'\rangle\rangle} = \text{True} \end{aligned}$$

Kaplan distinguished a formula's validity (truth in every possible context of utterance) from its necessity (truth in every circumstance for every context). This was an essential part of his program devoted to showing that there are truths which are valid, but not necessary. His examples of such formulae included *I am here now* and *I exist*. Thomason (1974:65-8) and Montague (1968:section 3) also discuss the desirability of representing the special status of such truths. What Kaplan calls "validity", they call "pragmatic validity"; and what Kaplan calls "necessity", they call "semantic validity". Their usage is closer to general custom, since Kaplan's "necessity" is very similar to what is generally called "validity", tout court. We could follow them, and perhaps coin the terms *P-valid* and *S-*

³⁸ Cf for instance the IQ* translation of the LD* representation of the example in section 5.1 below.

valid (and *P-satisfiable* and *S-satisfiable*). However, a good deal of our discussion will be about what we would then have to call P-satisfiability. On grounds of mere elegance, we therefore follow Kaplan in talking of validity, satisfiability and necessity.

Having removed personal and locational indexicals from the object-language to derive LD*, we cannot prove the particular results about *I am here now* and *I exist*. However, for some formula ϕ of LD*, it can be shown that (5) is valid, but not necessary.

$$(5) \quad \neg(N\phi \leftrightarrow K\phi)$$

The proof is simple: (5) is valid iff, for all contexts, it's not the case that the truth value of $N\phi$ is the same as that of $K\phi$. That is, (5) is valid iff for all contexts, $N\phi$ and $K\phi$ differ in truth value. For this to be the case, all that is required is that ϕ be picked so that its truth value alternate from day to day. But with the same ϕ , (5) is necessarily true iff, for all contexts and circumstances, $N\phi$ and $K\phi$ differ in truth value. Suppose ϕ is true at some context-circumstance pair. Then $N\phi$ will be true for all context-circumstance pairs sharing the same context. Take the context-circumstance pair at which the circumstance's time index is the day after the context's time index. $K\phi$ will be true at this pair also. Thus $N\phi$ and $K\phi$ will share a truth value at some context-circumstance pair. Thus (5) is not necessarily true. (In the terms suggested above, it is P-valid, but not S-valid).

So we can see that LD* can contain theorems which are not necessary truths. And by the equivalence given at the beginning of this section, IQ* can capture them also. The IQ* representation of LD* necessity differs in an interesting respect from the IQ* representation of LD* validity. While in the latter case, we could show that validity effectively arose only for tensed sentences of IQ*, this is not so for necessity. And this is an intuitively appealing result: for Kaplan, the issue of necessity arises when we ask whether, for the content (proposition) expressed by a wff in a context, that content is true in all circumstances. In IQ*, then, this result is captured by the fact that the wffs of the theory which might be necessarily true are *detensed* wffs. And we argued in Chapter 5 that it was the detensed formulae of IQ which corresponded to the propositional content of utterances.

6.5 How Not to Kaplan a Richards-Oberlander

In section 4, we showed how to represent various formal properties of the system based on Kaplan's LD within the system based on IQ, the framework invented by Richards, and elaborated in this thesis. In this section, however, we shall consider an example which seems

to indicate that the resources of LD* are not sufficiently powerful to represent all the formal properties of IQ*. Thus while we can, so to speak, Richards-Oberlander a Kaplan, we may not be able to Kaplan a Richards-Oberlander. In what follows, we are considering LD* without the terms included in section 2.1 under the heading ‘‘Additional Primitive Symbols for LD*/IQ* Equivalence’’, and thus without the semantic clauses supplied for those expressions. These symbols are the **solution** to the problem outlined in this section. They will be introduced in section 6.

6.5.1 A Counterexample?

Consider the English sentence (6).

- (6) It will rain yesterday

In Chapter 3 of the thesis, it was observed that IQ gives sentences such as (6) representations whose truth conditions cannot be met, since they involve a mismatch between the intervals specified by the tense and the indexical. On these grounds, such sentences were deemed to be semantically incoherent. Using only the resources of IQ*, we are now in a position to be rather more precise about this notion of incoherence: (6) is anomalous because it is rendered unsatisfiable in IQ*. And it is here that a significant difference between IQ* and LD* emerges: LD* can only represent (6) with a satisfiable wff. In the face of this fact, and the fact that neither theory renders the content of (6) necessarily false, serious problems seem to arise for LD*.

Let us take (6) both ways: first we shall represent it in LD*, and translate it into IQ*; then we shall represent it in IQ* directly, and translate it into LD*. The LD* representation of (6) will be (7). By the translation theorem, and the assumption that Y_t is the translation of Y, (7)’s IQ* translation is (8).

- (7) FY (It rain)
 (8) $Gv't'PRES_{(v',t')}Gv''t''FUT_{(v'',t'')} [Y_t (It rain)]$

Is (7) satisfiable, and if so, is its translation satisfiable? To see whether this is so, consider the definition of satisfiability given in section 4.2. A wff will be satisfiable iff there exists a context $\langle w, i \rangle$ such that the wff is true there. Now, this means that, if we can show that (7) can be true with respect to some index $\langle \langle w, i \rangle, \langle w', i' \rangle \rangle$, (7) is satisfiable. What would have to be the case for this to be so? By the definitions in section 2.3, (7) is true at $\langle \langle w, i \rangle, \langle w', i' \rangle \rangle$ iff there is some $i'' > i'$ such that (9) is true at $\langle \langle w, i \rangle, \langle w', i'' \rangle \rangle$.

(9) Y (It rain)

(9) is true at $\langle\langle w, i \rangle, \langle w', i' \rangle\rangle$ iff (10) is true at $\langle\langle w, i \rangle, \langle w', i-1 \rangle\rangle$.

(10) It rain

So, if it rained the day before the context of utterance of (6), LD* could make its representation (7) true; hence the formula (7) is satisfiable.

Now, is (7)'s IQ* translation (8) satisfiable? It will be, so long as there is some context $\langle w, i \rangle$ such that (8) is true at $\langle\langle w, i \rangle, \langle w', i' \rangle\rangle$. By the definitions in section 3.3, (8) will be true there iff $w' = w$, $i' = i$ and there is some $i'' > i'$ such that (11) is true at $\langle\langle w, i \rangle, \langle w', i'' \rangle\rangle$.

(11) Y_t (It rain)

(11) is true at $\langle\langle w, i \rangle, \langle w', i'' \rangle\rangle$ iff $i'' = i-1$ and (10) is true at $\langle\langle w, i \rangle, \langle w', i'' \rangle\rangle$. Now, since there is no relationship specified between i and i' , there is no reason why i' cannot be earlier than i , so that i'' can be both later than i' and earlier than i . Thus the IQ* translation of the LD* representation of (6) is also satisfiable.

The situation is completely different if we give (6) its IQ* representation directly. Let this representation be (12).

(12) $FUT_{(v,i)} [Y_t \text{ (It rain)}]$

Is this formula satisfiable in IQ*, and if it is, is its LD* translation satisfiable in LD*? This time, let us answer the first question before attempting the second. (12) will be satisfiable if there is a context $\langle w, i \rangle$ for which it is true. By definitions, (12) is true at $\langle\langle w, i \rangle, \langle w', i' \rangle\rangle$ iff $i = i'$, $w = w'$ and there is some $i'' > i'$ such that (11) is true at $\langle\langle w, i \rangle, \langle w', i'' \rangle\rangle$.

(11) Y_t (It rain)

(11) will be true at $\langle\langle w, i \rangle, \langle w', i'' \rangle\rangle$ iff $i'' = i-1$ and (10) is true at $\langle\langle w, i \rangle, \langle w', i'' \rangle\rangle$.

(10) It rain

This time, the conditions cannot be met. For $i = i'$, $i'' > i'$, yet $i'' = i-1$, and hence $i'' < i'$. (12) cannot be made true for any $\langle w, i \rangle$. So the IQ* representation of (6) is not satisfiable.

The question now re-presents itself: is the LD* translation of (12) satisfiable? This question can only be answered if we know what the LD* translation of (12) is, and armed with a

good translation, it might prove possible to give an LD* expression which is also unsatisfiable, while explaining why the asymmetry should have arisen.

An obvious explanation for the anomaly lies in the parametric nature of IQ* tense. (12) contains parametric tense; (8) did not. So it is natural to argue that it is on these grounds that (12) is unsatisfiable, and infer from this that all that LD* needs to capture this property is some apparatus to simulate full parametric tense. Once this position has been reached, it only remains to choose the appropriate combination of operators to stand in for parametric tense. An obvious possibility is to prefix any LD* wff ϕ with A and N to form AN ϕ ; this would certainly ensure that, rather than considering the truth of a formula relative to an arbitrary context-circumstance pair, we must look at its truth relative to the particular context-circumstance pair where the circumstance is the context.

Let's try this representation, before turning to a general argument against the possibility of representing the right relationships in LD*. The translation of (12) will be (13):

(13) ANFY (It rain)

Is this satisfiable? It is, if there is a context where it can be made true. So, by definition, (13) is true at $\langle\langle w, i \rangle, \langle w', i' \rangle\rangle$ iff (7) is true at $\langle\langle w, i \rangle, \langle w, i \rangle\rangle$.

(7) FY (It rain)

(7) is true at $\langle\langle w, i \rangle, \langle w, i \rangle\rangle$ iff there is some $i'' > i$ such that (9) is true at $\langle\langle w, i \rangle, \langle w, i'' \rangle\rangle$.

(9) Y (It rain)

And (9) is true at $\langle\langle w, i \rangle, \langle w, i'' \rangle\rangle$ iff (10) is true at $\langle\langle w, i \rangle, \langle w, i-1 \rangle\rangle$.

(10) It rain

Is (13) thereby unsatisfiable? The answer is no, for although we managed to start evaluating the formula relative to the index $\langle\langle w, i \rangle, \langle w, i \rangle\rangle$, the indexical operator Y can always afford to "throw away" whatever index has been handed to it by the truth-conditions. As a result, therefore, no relationship is required between the index at which (10) is true and the index supplied by the tense operator F. A and N are not enough. In fact, as we shall see in the next section, the operators LD* has at its disposal are just insufficient to capture the unsatisfiability of the IQ* formula.

Before proceeding to the general proof, it is worth noting in passing that the unsatisfiability problem is not a trivial one. For although (12) is not satisfiable in IQ*, (8) is not

necessarily false; in the case of (8), the tenses are not parametric, and thus the LD*/IQ* asymmetry disappears. This fact suggests that IQ* should manage to explain a fact about English for which LD* is lost for words. Consider (14) and (15).

- (14) ?Sam said that it will rain yesterday
 (15) Sam said that it would rain yesterday

Although we do not enter into the intricacies of embedded reports here, it should be clear that, since LD* doesn't rule out (6), it won't rule out (14). IQ* should rule it out alright, because it rules out (6). On the other hand, neither LD* nor IQ* should rule out (15); LD* certainly won't, and the fact that (8) is not necessarily false in IQ* suggests that (15) could be true there too.

6.5.2 Proof of Untranslatability

The intuition underlying the attempt to use A and N to simulate a tense was the right one. The difference between IQ* and LD* is that tensed formulae of IQ* considered relative to a context will take only one context-circumstance pair to true, whereas a tensed formula of LD* will take many to true. The same difference holds for indexicals: in IQ*, a formula of the form $Y_t\phi$ will go to true at an index only if the time of the circumstance is the day before the time of the context, and ϕ is true at the time of the circumstance; by contrast, in LD*, a formula of the form $Y\phi$ will go to true at any index whatsoever, so long as ϕ is true at the possibly distinct index at which the time of the circumstance is the day before the time of the context.

While IQ* can make its formulae evaluate to true, relative to a context, at only one circumstance, LD* seems unable to prevent its formulae evaluating to true, relative to a context, at many indices. We shall now prove that, with only its current temporal operators, LD* cannot define a tense of IQ*.

With regard to semantic definability, there are two varieties that are of interest: general and structure-relative. A notion ψ (such as a modal or tense operator) is *generally definable* in terms of the notions ψ_1, \dots, ψ_n (a list which does not contain ψ) just in case there is a formula $\phi[\psi_1, \dots, \psi_n]$ involving only ψ_1, \dots, ψ_n such that

$$\models \phi[\psi_1, \dots, \psi_n] \leftrightarrow \psi$$

“ \models ” means “is valid”, as before. So, in our case, $PRES_{(v,t)}\phi$ will be generally definable in terms of some LD*-operators ψ_1, \dots, ψ_n just in case there is an LD* wff $\theta[\psi_1, \dots, \psi_n]$ such

that

$$\theta(\psi_1, \dots, \psi_n] \leftrightarrow \text{PRES}_{(v,t)}\phi$$

is true in every structure. We can say, then, that if $\text{PRES}_{(v,t)}\phi$ is generally definable in LD^* , then we can understand $\text{PRES}_{(v,t)}\phi$ wholly on the basis of LD^* -operators without making any presuppositions concerning the atomic wffs. To put it another way, if $\text{PRES}_{(v,t)}\phi$ (which is, after all, a wff of IQ^* , not LD^* , as it stands) were to be added to LD^* , then two possibilities are opened up. Either it adds expressive power to LD^* , or it is redundant. It is redundant iff it can be generally defined as above.

Now, it is easy to show that if we pick some tautology T , $\text{PRES}_{(v,t)}T$ is not generally definable in LD^* . Thus, to add it to LD^* would be to add expressive power; LD^* and IQ^* are not, as it stands, intertranslatable. In what follows, we shall ignore world indices, for the sake of clarity and brevity; we can think of the model structures as simply $I \times I$; the model will be an assignment from pairs of indices to truth values. This means, of course, that we do not deal with the LD^* operator A , since it is cashed in terms of worlds; but what applies to LD^* 's N with respect to temporal indices applies to A with respect to world indices.

Definition:

A wff ϕ denotes an *eternal* proposition

iff

$\forall i$, if $\llbracket \phi \rrbracket^{<i,i>} = T$, then $\forall j$, $\llbracket \phi \rrbracket^{<i,j>} = T$.

It can be proved from this that, if ϕ denotes an eternal proposition and $\llbracket \phi \rrbracket^{<i,i>} = F$, then $\forall j$, $\llbracket \phi \rrbracket^{<i,j>} = F$.

Convention:

With the interpretation function J , we can write $\llbracket \phi \rrbracket^J$, or just ϕ^J for the proposition assigned to the wff ϕ .

Lemma:

Let $\psi[\phi_1, \dots, \phi_n]$ be a LD* wff, and let J assign eternal propositions to each of ϕ_1, \dots, ϕ_n .
Then $\llbracket \psi \rrbracket^J$ is eternal.

Proof:

By induction on the structure of the wff ϕ and the operators $\&$, $-$, N , Y , T , K , L , F and P (A is not required).

There are five types of case; we will show it for one example in each type.

Case 1: Atomic wffs

The atomic wffs have the property of eternity by assumption.

Case 2: $\&$, $-$

Assume: $\llbracket \phi \rrbracket^J$ and $\llbracket \psi \rrbracket^J$ are eternal

Prove: so are $\llbracket \phi \& \psi \rrbracket^J$ and $\llbracket \neg \phi \rrbracket^J$.

Show it for $\&$; Let $\llbracket \phi \& \psi \rrbracket^{J \langle i, i' \rangle} = T$

Then $\llbracket \phi \rrbracket^{J \langle i, i' \rangle} = T$ and $\llbracket \psi \rrbracket^{J \langle i, i' \rangle} = T$

By assumption, ϕ^J and ψ^J are eternal.

So

$\forall j, \llbracket \phi \rrbracket^{J \langle i, j \rangle} = T = \llbracket \psi \rrbracket^{J \langle i, j \rangle}$

Hence

$\forall j, \llbracket \phi \& \psi \rrbracket^{J \langle i, j \rangle} = T$

So

$\llbracket \phi \& \psi \rrbracket^J$ is eternal.

Case 3: N , Y , T

Assume: $\llbracket \phi \rrbracket^J$ is eternal

Prove: so are $\llbracket N\phi \rrbracket^J$, $\llbracket Y\phi \rrbracket^J$ and $\llbracket T\phi \rrbracket^J$.

Show it for Y; Let $\llbracket Y\phi \rrbracket^{J\langle i,i' \rangle} = T$

Then by definition of Y, $\llbracket \phi \rrbracket^{J\langle i,i'-1 \rangle} = T$

By assumption, ϕ^J is eternal.

Hence

$\forall j, \llbracket Y\phi \rrbracket^{J\langle i,j \rangle} = T$

So

$\llbracket Y\phi \rrbracket^J$ is eternal.

Case 4: K, L

Assume: $\llbracket \phi \rrbracket^J$ is eternal

Prove: so are $\llbracket K\phi \rrbracket^J$ and $\llbracket L\phi \rrbracket^J$.

Show it for K; Let $\llbracket K\phi \rrbracket^{J\langle i,i' \rangle} = T$

Then by definition of K, $\llbracket \phi \rrbracket^{J\langle i,i'-1 \rangle} = T$

By assumption, ϕ^J is eternal and time is infinite ³⁹.

Hence

$\forall j, \llbracket \phi \rrbracket^{J\langle i,j-1 \rangle} = T$

It follows that

$\forall j, \llbracket K\phi \rrbracket^{J\langle i,j \rangle} = T$

So

$\llbracket K\phi \rrbracket^J$ is eternal.

Case 5: F, P

Assume: $\llbracket \phi \rrbracket^J$ is eternal

Prove: so are $\llbracket P\phi \rrbracket^J$ and $\llbracket F\phi \rrbracket^J$.

Show it for F; Let $\llbracket F\phi \rrbracket^{J\langle i,i' \rangle} = T$

Then by definition of F, $\exists j > i'$ such that $\llbracket \phi \rrbracket^{J\langle i,j \rangle} = T$

By assumption, ϕ^J is eternal

So

³⁹ Time simply has an integer structure in the models for LD* and IQ* given in sections 2 and 3 above; it could have a more complex structure if necessary; but if it is not infinite in extent, we could in general define IQ* operators by a process of enumerating the indices at which the IQ* metalanguage equations hold. So, we might

$$\forall k, [\phi]^{J\langle i, k \rangle} = T$$

And

$$\forall k, \exists k' > k \text{ such that } [\phi]^{J\langle i, k' \rangle} = T$$

Thus

$$\forall k, [F\phi]^{J\langle i, k \rangle} = T$$

Hence

$[F\phi]^J$ is eternal.

By induction through cases 1 to 5, the lemma is proved. We have shown that if a wff ϕ is interpreted so that it is true everywhere, then a wff of the form Operator- ϕ will be true everywhere also. Mutatis mutandis for falsehood.

Theorem:

Where T is a tautology such as $(\phi \vee \neg\phi)$, $PRES_{(v,t)}T$ is not generally definable in LD^* .

Proof:

Assume $PRES_{(v,t)}\phi$ is definable.

Then $\forall\phi, \exists$ an LD^* wff ψ^ϕ such that

$$\models \psi^\phi \leftrightarrow PRES_{(v,t)}\phi$$

Consider the case where $\phi = T$ (eg $(\theta \vee \neg\theta)$)

Then

$$\models \psi^T \leftrightarrow PRES_{(v,t)}T$$

Assume a model in which all atomic wffs θ are such that θ^J is eternal. From the lemma, it follows that all wffs of any form are eternal.

Thus $[\psi^T]^J$ is eternal.

However, $[PRES_{(v,t)}T]^J = \{\langle i, i \rangle : i \in I\}$

This proposition is not eternal.

For $\models \psi^T \leftrightarrow PRES_{(v,t)}T$ to be true, the LHS and RHS must give the same proposition.

Now, $[PRES_{(v,t)}T]^{J\langle i, i \rangle} = T$

So, if $\models \psi^T \leftrightarrow PRES_{(v,t)}T$

Then

say that $IQ^* + \text{finite time} = LD^*$.

$$[\psi^T]^{J\langle i, i \rangle} = T$$

But

$$[\psi^T]^{J\langle i, i+1 \rangle} = T$$

So, by assumption that $PRES_{(v,t)}\phi$ is definable,

$$[PRES_{(v,t)}T]^{J\langle i, i+1 \rangle} = T$$

But this is false, for $PRES_{(v,t)}T$ is true only where the second index equals the first. The assumption of definability leads to contradiction.

So, from the lemma and the theorem, we can see that $PRES_{(v,t)}\phi$ is not generally definable in LD*; it cannot be added and defined away. The reason for this lies in the basic difference between LD* and IQ* which can be expressed in terms of the eternity property. In a model (for both LD* and IQ*) which happened to make each atomic wff true at all indices (or false at all indices), the operators of LD* would make all complex wffs true at all indices (or false at all indices) as well. By contrast, the operators of IQ* would not preserve eternity in this way. So, in the general case, LD* logical operators are *eternity-preserving*, and IQ* tense and indexical operators are *eternity-disturbing*, so to speak.

We may therefore say that, if an atomic wff taken relative to a context evaluates to true at more than one circumstance-index, the following result holds. Taking LD* without the added “Additional Primitive Symbols”, the complex sentences of LD* formed will also be able to evaluate to true at multiple indices. So LD* simply doesn’t have the ability to restrict the truth of sentences taken in contexts to one index only. It is as a direct result of this that Kaplan’s tense and indexical operators do not place restrictions on the intervals at which wffs evaluate to true; and it is because of this that formulae remain satisfiable which IQ* would deem unsatisfiable on grounds of indexical/tense mismatch.

Indeed, the indexical operators of LD* are not just eternity-preserving; they are eternity creating, in the following sense. If the atomic wffs upon which they operate go to true at one context-circumstance pair, the indexical wffs will go to true for that context at *all* circumstance indices. Showing that $PRES_{(v,t)}$ is not generally definable within the unaugmented LD* of this section has demonstrated that LD* doesn’t have tenses or indexicals which will limit the truth of wffs to single indices. As things stand, this property leads to the difference in expressive power evinced by the conflicting satisfiability conditions examined in section 5.1; the two systems are not currently mutually translatable, in the sense that do not now render all and only the same wffs true, given the same model. In the next section, we introduce the new primitive symbols which allow LD* the luxury of single-index truths. With these in hand, it seems as though it might after all be possible to

represent the Richards-Oberlander system in Kaplan's system.

6.6 How To Do It

In the previous section, we showed that unless something is added to it, the object-language of LD* would be unable to represent the property of parametric IQ* wffs which allows them to evaluate to true at one context-circumstance index only. In this section, we shall first indicate how the restrictions work in IQ*, then introduce into LD* the additional primitive symbols which can replicate these restrictions, and finally apply them to the *It will rain yesterday* case.

The way tenses and indexicals work in IQ* is by placing restrictions on the intervals at which a formula may evaluate to true; this often involves equational conditions on the temporal (and, in the case of tenses, modal) indices at which the formula is being evaluated. To see what this means, and to compare it with what LD* does with indexicals, take the semantic clauses each system gives for *yesterday*:

- (16) $\llbracket Y_t \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} f, g_c = T$
iff
 $g_c(t) = i' + 1$ and $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} f, g_c = T$
- (17) $\llbracket Y \phi \rrbracket^{<\langle w, i \rangle, \langle w', i' \rangle>} = T$
iff
 $\llbracket \phi \rrbracket^{<\langle w, i \rangle, \langle w', i-1 \rangle>} = T.$

In IQ*, $g_c(t)$ will return i ; so the restriction stated is that $i = i' + 1$; meanwhile the contained formula ϕ must be true at i' - the same index at which $Y_t \phi$ had to be true. In LD*, on the other hand, ϕ has to be true at $i-1$; but there is no demand that $Y \phi$ be true at that index, nor that $i-1 = i'$ (ie that $i = i' + 1$). So, as we saw in section 5.2, $Y \phi$ can be true-in-LD* at many indices; $Y_t \phi$ can be true-in-IQ* at an index only if the time of the circumstance equals the day before the time of the context⁴⁰.

To reiterate: what's missing from LD* is an object-language expression which can invoke these metalanguage equations, in the way the parametric expressions of IQ* do⁴¹. And the "Additional Primitive Symbols" included in the formulation of LD* in section 2 fill this restrictive role. Recall:

⁴⁰ In IQ proper, of course, "yesterday" is defined in terms of subintervals rather than equations. But the point stands: a restriction is placed on the existing interval of evaluation; we don't evaluate relative to a brand-new interval.

⁴¹ The operator A , borrowed from LD* by IQ*, is not parametric, and thus does not resemble a true indexical in this way. Like the Kaplan operators in general, it doesn't invoke a metalanguage equation.

- 10 A temporal constant: S_time
- 11 A modal constant: S_world
- 12 An infinite set of temporal variables: V_T
- 13 An infinite set of modal variables: V_V

The constants are just like the *I* and *Here* which Kaplan included in the original formulation of LD. The variables have semantic clauses which allow them to pick out the times and worlds of the circumstances relative to which they are evaluated. With these additional devices, it is quite simple to express, in the LD* object-language, equations which will have the same effects in the metalanguage as the parametric expressions of IQ*.

- (18) $[S_time = t']^{<<w,i>,<w',i'>>}$
- (19) $[S_world = v']^{<<w,i>,<w',i'>>}$

(18) will be true iff $i=i'$; (19) will be true iff $w=w'$. If the parametric tenses of IQ* are to be simulated, then the ordinary Priorian tenses of LD* need to be accompanied by occurrences of both (18) and (19). If a parametric indexical is to be simulated, then a suitably embedded occurrence of (18) must be used.

The use of these expressions can be made much clearer by example; and the obvious case to treat is (6), whose IQ* representation is (12):

- (6) It will rain yesterday
- (12) $FUT_{(v,t)} [Y_t (It\ rain)]$

Section 7 gives the full translation function from IQ* into LD*; for the moment it will suffice to recognise the following (assume that ϕ is atomic):

- (20) $FUT_{(v,t)}\phi \quad \longrightarrow \quad (S_time = t') \ \& \ (S_world = v') \ \& \ F\phi$
- $Y_t\phi \quad \longrightarrow \quad L[(S_time = t') \ \& \ K\phi]$

Notice that the L and K operators “cancel”, so that in the translation of $Y_t\phi$, ϕ is to be considered relative to the same index as $Y_t\phi$ would have been. Now, (12) will be translated as (21):

- (21) $(S_time = t') \ \& \ (S_world = v') \ \& \ FL[(S_time = t') \ \& \ K\phi]$

This formula is unsatisfiable in LD*. For, relative to an index $<<w,i>,<w',i'>>$, it will be true only if $i=i'$, $w=w'$, and there is some $i''>i'$ such that $i=i''+1$, and ϕ is true at $i''+1$. But then $i'=i$, and i is later than i'' . Inconsistency results: the LD* translation of the IQ* wff preserves unsatisfiability.

So, one coherent way for LD* to portray the previously elusive properties of IQ* formulae is by adding these new primitive symbols to the LD* object-language. The extension might

be thought non-conservative, since wffs which were previously satisfiable are no longer satisfiable; but of course, the old wffs are still satisfiable; we have merely added new wffs which aren't satisfiable (and of course, new wffs which are satisfiable too). In the next section, we give the full translation functions from LD* into IQ*, and back again.

6.7 The Translation Functions

Both σ_1 and σ_2 are top-down translation functions.

LD operators*

A = actually

P = past

F = future

K = day before

L = day after

Y = yesterday

T = tomorrow

N = now

New LD terms*

S_time = speech time

t' = evaluation time

S_world = speech world

v' = evaluation world

6.7.1 σ_1 : from LD* into IQ*

Where ϕ is an LD* wff containing no new terms, tense or demonstrative symbols,

ϕ	\longrightarrow	$Gv't'PRES_{(v',t')}\phi$	Other cases:
$A\phi$	\longrightarrow	$Gv't'PRES_{(v',t')}[A(\sigma_1(\phi))]$	
$P\phi$	\longrightarrow	$Gv't'PAST_{(v',t')}(\sigma_1(\phi))$	
$F\phi$	\longrightarrow	$Gv't'FUT_{(v',t')}(\sigma_1(\phi))$	
$K\phi$	\longrightarrow	$Gv't'PAST_{(v',t')}[Y_{t'}(\sigma_1(\phi))]$	
$L\phi$	\longrightarrow	$Gv't'FUT_{(v',t')}[T_{t'}(\sigma_1(\phi))]$	
$Y\phi$	\longrightarrow	$Gv't'PAST_{(v',t')}[Y_{t'}(\sigma_1(\phi))]$	
$T\phi$	\longrightarrow	$Gv't'FUT_{(v',t')}[T_{t'}(\sigma_1(\phi))]$	
$N\phi$	\longrightarrow	$Gv't'PRES_{(v',t')}[N_{t'}(\sigma_1(\phi))]$	

Let $\Gamma = (S_time = t')$ and $\Delta = (S_world = v')$; then

$\Gamma \ \& \ \phi$	\longrightarrow	$N_{t'}(\sigma_1(\phi))$
$\Gamma \ \& \ \Delta \ \& \ \phi$	\longrightarrow	$PRES_{(v,t)}(\sigma_1(\phi))$

6.7.2 σ_2 : from IQ* into LD*

Where ϕ is an IQ* wff containing no indexical/tense symbols,

ϕ	\longrightarrow	ϕ ; Other cases:
$\text{PRES}_{(v,t)}\phi$	\longrightarrow	$(S_time = t') \ \& \ (S_world = v') \ \& \ \sigma_2(\phi)$
$\text{PAST}_{(v,t)}\phi$	\longrightarrow	$(S_time = t') \ \& \ (S_world = v') \ \& \ P(\sigma_2(\phi))$
$\text{FUT}_{(v,t)}\phi$	\longrightarrow	$(S_time = t') \ \& \ (S_world = v') \ \& \ F(\sigma_2(\phi))$
$\text{Gv't'PRES}_{(v',t')}\phi$	\longrightarrow	$\sigma_2(\phi)$
$\text{Gv't'PAST}_{(v',t')}\phi$	\longrightarrow	$P(\sigma_2(\phi))$
$\text{Gv't'FUT}_{(v',t')}\phi$	\longrightarrow	$F(\sigma_2(\phi))$
$Y_t\phi$	\longrightarrow	$L[(S_time = t') \ \& \ K(\sigma_2(\phi))]$
$T_t\phi$	\longrightarrow	$K[(S_time = t') \ \& \ L(\sigma_2(\phi))]$
$N_t\phi$	\longrightarrow	$(S_time = t') \ \& \ \sigma_2(\phi)$
$A\phi$	\longrightarrow	$A(\sigma_2(\phi))$

Where B is any sequence of IQ* operators, and $[\sigma_2 B]$ its LD* translation:

$\text{Gt'BY}_t\phi$	\longrightarrow	$[\sigma_2 B]K(\sigma_2(\phi))$
$\text{Gt'BT}_t\phi$	\longrightarrow	$[\sigma_2 B]L(\sigma_2(\phi))$
$\text{Gt'BN}_t\phi$	\longrightarrow	$[\sigma_2 B](\sigma_2(\phi))$

6.7.3 Worked Examples

Before proceeding to discuss a couple of worked examples, there are three points to note: first, σ_1 is the function from LD* into IQ* which was less precisely referred to as σ in sections 4 and 5. Secondly, the translations given for the deparametrized indexicals of IQ* stand in the way of a fully top-down translation; this is, however, a relatively small price to pay for the truth-conditional equivalence which σ_2 thereby guarantees. Thirdly, the translations for the equations formed from the new terms added to LD* are, in essence, contextual definitions; although we will not do so, we could replace them with logically equivalent, non-contextual definitions such as those in (22), where $\alpha=\alpha$ is a logical truth:

$$\begin{aligned}
 (22) \quad \Gamma &\longrightarrow \text{Gv'PRES}_{(v',t')}(\alpha=\alpha) \\
 \Delta &\longrightarrow \text{Gt'PRES}_{(v,t')}(\alpha=\alpha) \\
 \phi &\longrightarrow \text{Gv't'PRES}_{(v',t')}\phi
 \end{aligned}$$

Since σ_1 and σ_2 are translations functions which deliver truth-conditional equivalents in the two systems, it should be possible to translate from LD* to IQ* and back again (or vice versa). In so doing, we can derive for LD*, for instance, the IQ*-normal form of its wffs. We'll look at a single example, and treat it two ways: starting with its LD* representation, and starting with its IQ* representation. Consider the simple sentence (23), its LD* representation (24), and its IQ* representation (25):

- (23) Jane left town yesterday
 (24) PY (Jane leave town)
 (25) PAST_(v,t) [Y_t (Jane leave town)]

Now, taking the LD* representation, we can derive the IQ* translation of (24) given in (26), by applying σ_1 .

- (26) Gv't'PAST_(v',t') [Gv''t''PAST_(v'',t'') [Y_t [Gv'''t''' PRES_(v''',t''') (Jane leave town)]]]

It's perhaps worth noting first that the double deparametrized past in (26) is equivalent to a single deparametrized past; secondly, it is possible, given what little Kaplan says about the ability of his LD to capture natural language examples, to take an LD* representation of (23) to involve no tense at all, only an indexical ⁴². If this were so, then we would again derive an IQ* translation with a single deparametrized past. Now, we may apply σ_2 to (26), to derive (27).

- (27) PPL[(S_time = t') & K (Jane leave town)]

So, this is the IQ* normal form of the LD* wff (24). It can be paraphrased as “there is some time in the past at which the day after that past time is the day of speech, and the day before that day after, Jane left town”.

By applying σ_1 and σ_2 in reverse order to the IQ* wff, we can similarly derive its LD* normal form. (28) is the result of applying σ_2 to (25):

- (28) S_time = t') & (S_world = v') & PL[(S_time = t') & K (Jane leave town)]

Notice that the semantics of (S_time = t') is such that (28) will be satisfiable. (29) is then derived by applying σ_1 to (28):

- (29) PRES_(v,t) [Gv't' PAST_(v',t') [Gv''t'' FUT_(v'',t'') [T_t.. [N_t [Gv'''t''' PAST_(v''',t''') [Y_t... [Gv''''t'''' PRES_(v''''',t''''') (Jane leave town)]]]]]]]

This is a very hairy formula. But what it says can be read as “The present time is such that there was some earlier time such that at a later time, which was a day after that earlier time, that later time was today, and at that time, there was a past time, a day earlier than the later time [ie, a day earlier than today], at which Jane left town”. It's truth-conditions are correct; it's just hard to say.

So the syntactic translations σ_1 and σ_2 seem to be able to render IQ* in LD* and vice versa; it looks as though we can both Richards-Oberlander a Kaplan, and Kaplan it back.

But there are some further issues which we may help us contrast the systems. It is to these issues that we now turn.

6.8 Outstanding Issues

We have demonstrated that, with an extension to a simple fragment of Kaplan's LD, we can generate a formal system LD* with which it is possible to compare the formal system IQ* based on the system IQ discussed at length in the thesis. Amongst other things, we have seen that notions of validity and necessary truth can be carried over from LD* into IQ*, and that the subtleties of IQ* tense and indexicals can apparently be simulated by introducing indexical equations into the object-language of LD*. However, there are a number of outstanding problems which seem to prevent the claim that LD* and IQ* are "notational variants" from going through. The first relates to the representation of scope relations in LD*; the second relates to the issue of temporal quantification and the question of bound indexicals.

6.8.1 Scope in LD*

One of the major points in favour of IQ* is that it allows us to carefully model the relationships between tenses and indexicals in such a way as to be able to say which tense an indexical (or its non-indexical equivalent) is related to; and which tenses are related to which other ones. It is of course the use of G which allows this flexibility; and the advantages of a sensitive approach to temporal scope relations should be manifest from chapter 4 of the thesis, which deals with scope in subordinate clauses. Now, in comparing LD* with IQ*, we have gone some way towards reproducing these relationships within LD*. But we will argue below that some of the scope relations LD* contains do not correspond to any natural language readings; an explanation of this fact will be canvassed. In considering this explanation, we will consider the wisdom of correlating the tense operators of LD* with the tenses of natural language.

Consider the following two wffs of LD* and the English sentence (32):

⁴² Cf Section 8.1 below.

- (30) PY (Fiona eat breakfast)
- (31) YP (Fiona eat breakfast)
- (32) Fiona ate breakfast yesterday

Intuitively, both these formulae represent (32). But if we assume the temporal structure for LD* given in section 2.1 and paraphrase (30) and (31) as Kaplan advises us, we must read them respectively as “It was the case that it was the case yesterday that Fiona ate breakfast” and “It was the case yesterday that it was the case that Fiona ate breakfast”. On the one hand, the latter reading makes it clear that (31) is no representation for (32), for it says that at some time *before* yesterday, Fiona ate breakfast. And this certainly doesn’t catch the meaning of (32). On the other hand, if we strictly interpret LD* in terms of its rational temporal structure, the reading we gave of (30) also leads us astray, for the indexicals in Kaplan’s system basically ignore any preceding temporal operators (this is one way of expressing the spurious satisfiability of example (6) in section 5.1).

There are at least two explanations we can give for these impressions. First, we might argue that (30) and (31) are not the representations LD* would assign to the English sentence (32). We have jumped to this representational conclusion, perhaps encouraged by the representation Dowty (1979:323-25) considers (and ultimately rejects) for such sentences within a Montague framework. The correct representation might rather be (33):

- (33) Y (Fiona eat breakfast)

This is read as “It was the case yesterday that Fiona ate breakfast”. Now such an argument suggests that LD* and IQ* are actually giving the semantics for very different operators: IQ* may indeed give a successful semantics for English tenses and indexicals, but LD* just isn’t doing the same thing. LD* is actually giving the semantics for *It was the case that* and *It was the case yesterday that*. Thus, what differences remain between IQ* and LD* could be explained by analogy to the difference between the enterprise of giving a semantics for quantified modal logic, and the enterprise of providing a semantic representation for the English words *possibly* and *necessarily*.

Secondly, a stronger version of such an explanation can be derived from the following position: not only are (30) and (31) not the representations LD* would assign to (32), but the fact of the matter is that LD* would not assign representations to (32) at all. That is not the function of LD* at all. LD* is a model of a fragment of English, but there is no promise that we should be able to translate from natural language into the formal language. Perhaps such a move might be encouraged by the Montague style of natural language semantics; but LD was not designed as a representational intermediate like IL, and LD* has inherited its parent’s functions and added no new ones to its repertoire. LD* tells us

how *It was the case that* interacts with *It was the case yesterday that*, and that is the end of the matter.

There is at least one further reason why we might wish to drive a wedge between the tense operators of LD*, and natural language tense. Consider a free hydrogen atom, which floats in empty space far, far away from any galaxy. Call the hydrogen atom “Harry”. It is matter of chance that Harry never combines with another atom to form a molecule; however, this means that (34) is a sentence which would, in LD*, denote a proposition of the type we called eternal:

- (34) Harry is free.
- (35) Harry was free.

Now, in natural language, if a speaker uses a past tense, as in (35), there is a very strong suggestion that, for one reason or another, the speaker is not committed to the truth of (34) at any time other than those times which fall before the time of speech. That is to say, the speaker is committing herself to the truth of the proposition denoted by (34) at only a subset of the set of temporal indices. Thus, in natural language, tense can be taken to be an eternity-disturbing device. But in LD*, the tense operators (and the indexical operators) may be said to be eternity-preserving. Since the proposition denoted in LD* by (34) is eternal (true at all temporal indices), so too is the proposition denoted by any sentence formed from it by an LD* operator. Thus, LD* would say that what is said in an utterance of (35) is, by chance, an eternally true proposition. And this conflicts with our intuitions about natural language discourse.

There is of course a solution to this, even within LD*, and that involves the introduction of the new primitive symbols of section 6, which simulate the eternity-disturbing character of the parametric expressions of IQ*. Doubtless, the wisdom of taking Harry’s uncombined state to underwrite non-eternal contents for tensed English sentences may be questioned.

- (6) It will rain yesterday

But given that we are right to use parameters to semantically block our old example (6), it should be clear from the argument above that on their own, the Priorian tense operators cannot correspond very closely to natural language tenses.

If the position suggested under the second option were to be adopted, then perhaps its adherents could consistently maintain their isolation from natural language semantics, together with an unaugmented version of LD*. Or they could even adopt LD* as presented here, but still stick to discussing the semantics of the artificial logical operators such as *It*

was the case that. But it would certainly remain true that the tense operators of LD* would not directly reflect the tenses which occur in natural language, and which are represented in IQ*. On this basis, those whose interests do lie in the provision of semantics for natural languages could justifiably rule LD* out of their considerations, not because of internal deficiencies, but because of it deals with something other than natural language. And if these considerations are not a sufficient thorn in its flesh, the ones surveyed in the next section could be poisonous.

6.8.2 Temporal Quantification and Bound Indexicals

We adverted to the temporal structure of LD* (and also, implicitly, of IQ*) above, in discussing scope relations. That structure currently uses rational numbers (specifically, integers) to stand for elements of the set I, intuitively interpreted as moments of time. Now, the full IQ system, of which IQ* is but a fragment, gained much of its original appeal from its treatment of temporal quantification in English. The quantifiers, in keeping with the interval basis of IQ, were defined in terms of (deictically picked out) intervals of quantification. Indeed, the use of relations defined over intervals is vital to their utility. At the same time, the temporal quantifiers can stand in scope relationships too, as they may be bound by the operator G.

The point is that neither IQ*, nor LD*, has intervals at its root, and to add temporal quantifiers to either system would be a major task. However, since this has not been attempted, it is perhaps worth noting how LD* would have to represent the bound indexicals of Chapters 2 and 4 of the thesis. We have mentioned the non-parametric analogues of *yesterday* and *tomorrow* in IQ*, and they form part of the IQ* translations of K and L from LD*. These non-parametric expressions are, of course, the expressions which IQ would use to represent bound indexicals. In IQ, they could occur in their classic contexts of temporal quantification, but in IQ* they have merely appeared as the representations of non-indexical constructions of English (or LD*).

What could LD* do about these expressions? The answer, of course, is that they would probably have to be treated in terms of K and L, and so any connexion between bound indexicals and unbound indexicals would effectively be lost in an extended object-language for LD*. Kaplan himself states that the resemblance between Y and K (G, in his presentation) is merely superficial (Kaplan (1977:84)); this being so, we would be forced to conclude that the resemblance between unbound indexicals and bound indexicals is also

merely superficial. Perhaps this would correctly reflect the fact that Kaplan never considered them as falling into the domain of his semantics for indexicals. But it would mean missing a generalisation that chapter 2 suggested should be explained by any theory of indexicals, and which chapters 3 and 4 were devoted to capturing.

6.9 Conclusions

The purpose of this chapter has not been to demonstrate the superiority of one indexical system over another, but to compare and contrast their distinctive features. From what has been said, three main points can be drawn. First, IQ^* is adequate to represent whatever LD^* can represent. Secondly, it seems that LD^* might not be as appropriate a tool as IQ^* for modelling English; on this point, superiority might be claimed for IQ^* , but cf the discussion in section 8.1.

Lastly, the significance of the intertranslatability result is that it allows us to see the deep-seated difference between LD^* and IQ^* which also, by implication, divides the full systems LD and IQ from one another. To be sure, both IQ^* and LD^* are possible representations of English. But one (IQ^*) represents the pragmatic unsatisfiability of anomalous sentences, which the other (LD^*) cannot, without extra primitive symbols. So while IQ^* and the full LD^* are intertranslatable, the result reflects back onto the original IQ and LD . These just can't be intertranslatable; and the differing semantics they give their indexicals is a major cause of this. In LD , the truth of an indexical formula ϕ with respect to a context-circumstance pair $\langle \langle w, i \rangle, \langle w', i' \rangle \rangle$ does not require any relation to hold between the context index $\langle w, i \rangle$ and the circumstance index $\langle w', i' \rangle$. In IQ , by contrast, the truth of an indexical formula with respect to a context-circumstance pair $\langle \langle w, i \rangle, \langle w', i' \rangle \rangle$ requires some relation between the time index of the contextual pair $\langle w, i \rangle$ and the time index of the circumstantial pair $\langle w', i' \rangle$. This arises from the fact that IQ 's indexicals can disturb eternity, while LD 's cannot. It is from this difference that the other differences arise, and we have seen that LD^* can contain new "non-kaplanian" terms which will invoke the appropriate relations.

In this way, we have located the IQ^* fragment with respect to the LD^* fragment based on Kaplan's Logic of Demonstratives. Thus, the third aim of the thesis has been achieved, and an account of the distinctive formal features of our semantics for temporal indexicals has been derived.

Chapter 7: Conclusions

This thesis was intended as a contribution to the understanding of pure temporal indexicals. How has that intention been realised? A generalisation which unites familiar indexical behaviour with more unusual behaviour has been embedded within an indexical interval semantics; the various ramifications of that move have been investigated. In order to assess whether the thesis has been successful, it's really necessary to rehearse the aims set out in Chapter 1, and to show that those aims have been satisfied. That's what we will do in section 1 below; section 2 will sketch a few ideas about further research.

7.1 The Aims Revisited

Pure repetition can, to some extent, be avoided, thanks to the fact that we may now enter into rather greater detail in discussing the targets set, and their execution. There were three primary aims. First, the thesis had to provide a unifying representation and explanation of two types of indexical evidence; and it had to do so within an indexical interval semantics. Secondly, the thesis had to examine the effects of accommodating indexicals upon the propositions of the chosen semantic theory; and the propositions derived had to be compared with those proposed under other well-known views. Lastly, the thesis had to provide a version of the proposed treatment of indexicals which was specified sufficiently precisely to allow comparison with an existing formal treatment of indexicals.

The first target was reached by three stages. In Chapter 2, we examined Kaplan's (1977) explanation of the behaviour of those indexicals we termed *unbound*. It was suggested that Kaplan's implicit claim that his notion of *direct reference* provided better empirical coverage than the scope proposal could be falsified. And the *bound* indexicals discussed next provided the means of falsification. For here was a second domain of indexical behaviour which could not be covered by Kaplan's theory. It was decided that a successful theory of temporal indexicals in natural language must (i) cover the data, (ii) distinguish indexicals from non-indexicals, and (iii) relate unbound indexicals to bound indexicals. In the second part of the chapter, we considered informally instances from this second domain, and canvassed various ideas about their origins.

By the end of the chapter, we had suggested that the unbound indexical had the semantic role of a *parametric* expression, and that the bound indexical was, by contrast, *non-*

parametric. Thus, it proved possible to suggest that there was a particular kind of relationship between the two domains of evidence. If unbound indexicals are the primary case, then bound indexicals were formed from them by a process of *deparametrization*. Or, to put it another way: unbound indexicals depend on extralinguistic context; bound indexicals are cut off from extralinguistic context by substitution. This unifying generalisation, then, had to be captured by the theoretical framework adopted in the subsequent chapters.

The second and third stages on the road to the first target involved embedding this generalisation within a pre-existing indexical interval semantics, and adapting that framework to represent the two types of indexicals. These stages were reached in Chapters 3 and 4; these chapters concentrating in turn on the representation of unbound and bound indexicals. The indexical interval semantics adopted was *IQ*, originally developed by Richards (1986); its essential features were outlined. The existing treatment of unbound indexicals was criticised, and replaced by a new representation. Under this representation, indexicals were rendered into the language of *IQ* with explicit parameters in their form. By considering a number of examples, the adequacy of this particular representation was demonstrated. The behaviour of unbound, parametric indexicals was thus accounted for in terms of their relationship to parametric tenses. The general strategy of parametrization adopted was then shown to be fertile, by applying it to a quantificational representation for perfective aspect.

Having thus shown in Chapter 3 that the parametric representation of indexicals could deal with unbound indexicals, we demonstrated in Chapter 4 that it could be used, in conjunction with the deparametrizing *G*-operator, to generate bound, non-parametric indexicals. In the course of showing this, we augmented the coverage of *IQ* by providing representations for conditionals and imperatives; furthermore, the introduction into *IQ* of *semi-parametric* tense allowed a new, general treatment of tenses in subordinate clauses, which can be used to explain certain sequence of tense phenomena. The fact that unquoted bound indexicals occur with temporal quantifiers could also be accounted for. Thus, taking together the Chapters 2 to 4, the first specific aim of the thesis was achieved, and significant insights into the selected formalism were provided.

The second main aim of the thesis was to carry out a detailed comparison of the propositions arrived at with those of Kaplan, Frege and Russell. The first part of Chapter 5 saw the elaboration of *IQ*'s existing *value-free/value-specific* distinction. In the light of the representation adopted for indexicals, and the correspondence between value-free propositions and the content of utterances, it became clear that the new version of *IQ* had to distinguish different types of value-freedom. Thus, propositions which are *temporally specific*

must be distinguished from those which are *temporally neutral*. And those which are *directed* must be distinguished from those which are *bare*. By considering in some detail remarks by Kaplan, and interpreting Frege's discussions of thought, sense and reference, it was shown that IQ has sufficient structure in its propositions to capture various desirable distinctions, without invoking undesirables such as a sense hierarchy. Finally, Russell's (1903) remarks about propositions were examined in order to show that IQ has the potential to explicate certain aspects of the Russellian programme. So Chapter 5 satisfied the second aim of the thesis by first analysing the modified IQ treatment of propositions, and secondly comparing that treatment with existing positions on propositions.

The final specific aim was approached in Chapter 6. Formal fragments of Kaplan's (1979) *Logic of Demonstratives* and the version of IQ propounded in Chapters 3 to 5 were compared. It was found that IQ can represent Kaplan's distinction between the validity and necessity of formulae; it was the desirability of making that distinction that motivated Kaplan's dissatisfaction with alternative treatments of indexicals. Further, it was proven that without special additions, LD* could not capture a vital aspect of IQ*'s approach to tense and indexicality. The reason for this lies in the fact that IQ*'s operators (and those of IQ proper) are *eternity disturbing*, in that they restrict the truth of wffs containing them to single world-time indices (or single time indices, in the case of indexicals). By contrast, LD*'s operators are *eternity preserving*, and can allow wffs containing them to be true at many world-time indices.

7.2 Further Directions

So, we may conclude that the thesis has reached the goals it set itself. There is a sense, however, in which a thesis is the beginning of a story rather than its end. For there are always loose ends, some of which may be gathered together and followed up. Some of the loose ends are really problems encountered, but left unsolved, by the thesis; others are tasks that were not undertaken in the thesis, but which should be tackled if the research programme of which it is a part is to mature; and of course, there are ideas just glimpsed during the thesis, which may turn out to offer promising avenues for further research.

In this case, most of the loose ends left hanging seem to lead towards further research, rather than back to specific unsolved problems. There is little point in going into great detail about ideas which are still very vague. Therefore, I will confine myself to a few brief comments about promising areas of study suggested by the thesis.

The thesis deals only with temporal indexicals. Other attempts to embody Kaplan's insights within a Montagovian framework (eg Bennett (1978)) have dealt with locational and personal indexicals as well. In order to improve the empirical coverage of our framework, it would be necessary to provide an analysis of such expressions. Perhaps this might involve changes to the models for IQ; perhaps not. If the former course were chosen, then the possibility of parametrizing the new indexicals would be raised. And if, for instance, personal indexicals were parametrized, then it might prove interesting to try to assimilate co-referential pronouns and even bound variable pronouns to deparametrized indexicals. It should be clear that any developments along these lines would have taken us far away from the aims set out in Chapter 1, but they are certainly worth investigating.

We mentioned in Chapter 3 that the classification of the temporal devices of IQ left open the possibility of there being expressions which were parametric, non-quantificational and unrelated to speech time. And natural languages, of course, might or might not contain such devices too. A possible candidate would be *Monday*; such an expression is context-sensitive and perhaps directly referential. But a speaker still has a choice as to which Monday she wishes to refer to. So it could be argued that there are English analogues of expressions which would fall into this category. Furthermore, there seem to be uses of *Monday* which are non-parametric also; (1) is ambiguous between parametric and non-parametric readings:

- (1) Monday is a bad day

If examples such as (1) needed to be represented, it seems as though IQ could do it.

Having mentioned Bennett (1978), it is perhaps worth pointing out that, if the IQ treatment of indexicals offered here is to form part of a maturing research programme, it will need to be embedded in a scheme like Bennett's. That is to say, to be considered a serious Montagovian natural language semantics, IQ will have to be used as a representation language, into which expressions of natural language are algorithmically translated. Up to now, we have relied on intuition concerning the appropriate translations. To some extent, those intuitions will guide us towards the correct translation rules; but much work has yet to be done here.

Another area where IQ shows promise, but further research would be needed, is the implementation of what has been called cognitive dynamics. The value-free propositions discussed in Chapter 5 have the kinds of properties which would be required in a database which had to represent knowledge concerning temporal relations.

The approach to IQ taken here certainly promises to illuminate another area of research, relating to sequence of tense phenomena. We laid the ground rules of a treatment in Chapter 4; it seems as though IQ's representations for tenses and indexicals will prove amenable to the modelling of much of the evidence relating to intrasentential tense behaviour.

Generalising from this would be one way of attacking tense interactions in multisentence discourses. In other words, if our account of intrasentential temporal relations is successful, we might not need a separate account of intersentential relations at all. Just to give a taste of the phenomena in question, consider the fact that there seem to be constructions in natural language whose explanation seems to require a notion of tense which reaches across sentence boundaries. For example, the sample discourse (2) contains a sentence whose tense might be explained in this way.

- (2) In 1957, Max bought an ailing newspaper. Twenty years later, he would be the richest man in London.

Within a single sentence represented in IQ, the natural language *would* is represented as a future tense falling within the scope of a past tense. In the second sentence of (2), there is no past tense available to construct this obvious representation. What is to be done? There are essentially three options: first, the requirement that *would* be constructed from a past tense and a future tense could be relaxed; secondly, it could be argued that there is an implicit past tense inside some sentences when they occur in discourse; lastly, it might be that the tense of one sentence of a discourse can be accounted for in terms of the tense of preceding sentences.

The last option seems to be the most realistic; however, it clearly requires a departure from a semantics which deals with sentences isolated from the discourses in which they occur. The phenomenon of intersentential sequence of tense represents a central problem standing in the way of a satisfactory semantics for handling temporal relations in text. To appreciate the problems an example such as (2) presents, compare it with (3).

- (3) In 1957, Max bought an ailing newspaper. Twenty years later, he was the richest man in London.

The only difference between the two cases is that (3) contains *was* where (2) contains *would be*. Now consider a possible continuation of either discourse, using the sentence (4):

- (4) He would be also be very unhappy

It's fairly clear that (4) can follow on from (2), but not (3). The reason for this must lie in the differing tenses of the second sentences of the two discourses. Systems such as that reported in Kamp and Rohrer (1983) can't yet deal with such examples. And if that's not bad enough, consider (5) and (6), minor variations on (2).

- (5) In 1957, Max bought an ailing newspaper. In twenty years time, he would be the richest man in London.
(6) In 1957, Max bought an ailing newspaper. In twenty years time, he will be the richest man in London.

If instances of (5) and (6) are uttered in 1986, they say rather different things about Max's wealth: the former locates it in 1977, the latter in 2006. The important difference in this case is that in (5), the second sentence looks at Max's fortunes from the perspective of 1957, whereas the second looks at them from the time of speech, 1986. There are lots of subtle interactions going on, involving tenses, adverbials and other constructions, and any framework which aims to represent them must be extremely sensitive. The suggestion here is that, given IQ's approach to single sentence interactions, it may already be sensitive enough to deal with the multisentence cases without significant alteration. If this is so, then there are reasons for thinking that IQ may be able to provide a formalisation of observations about the non-parametric use of *now* in narrative texts (cf Chapter 3, section 6.4, and Dry (1979)).

Section 1 of this final chapter showed that the thesis has achieved the aims it set itself. Section 2 indicated in outline that the loose ends left by the thesis lead to questions which are both intriguing and challenging. Now what? Well,

- (7) Never put off until tomorrow what you can do today

References

Note that editions of Frege's works are cited under their original publication details, but with their titles translated.

- Bar-Hillel, Y. (1954) Indexical Expressions. *Mind*, 63, 359-379.
- Barwise, J. and Perry, J. (1983) *Situations and Attitudes*. Cambridge, Mass.: MIT Press.
- Bennett, M. (1978) Demonstratives and indexicals in Montague grammar. *Synthese*, 39, 1-80.
- Blair, I. D. (1984) Situation Semantics and its Foundations. PhD Thesis, Centre for Cognitive Science, University of Edinburgh.
- Burge, T. (1977) Belief De Re. *Journal of Philosophy*, 74, 338-362.
- Burge, T. (1979) Frege and the Hierarchy. *Synthese*, 40, 265-281.
- Burge, T. (1979a) Sinning Against Frege. *Philosophical Review*, 88, 398-432.
- Butterfield, J. (1986) Content and Context. In Butterfield, J. (ed.) *Language, Mind and Logic*, pp91-122. Cambridge: Cambridge University Press.
- Chomsky, N. (1971) Deep structure, surface structure, and semantic interpretation. In Steinberg, D. D. and Jakobovits, L. A. (eds.) *Semantics: An interdisciplinary reader in philosophy, linguistics and psychology*, pp183-216. Cambridge: Cambridge University Press.
- Costa, R. (1972) Sequence of Tenses in That-Clauses. In Peranteau, P. M., Levi, J. N. and Phares, G. C. (eds.) *Papers from the Eighth Regional Meeting of the Chicago Linguistics Society*, Chicago, April 14-16, 1972, pp41-51.
- Davidson, D. (1968) On Saying That. *Synthese*, 19, 130-146. Reprinted in Davidson (1984) pp93-108.
- Davidson, D. (1984) *Inquiries into Truth and Interpretation*. Oxford: Clarendon Press.
- Dowty, D. (1979) *Word Meaning and Montague Grammar*. Dordrecht: D. Reidel.
- Dowty, D. R., Wall, R. E. and Peters, S. (1981) *Introduction to Montague Semantics*. Dordrecht: D. Reidel.
- Dry, H. (1979) Four Temporal Effects of Narrative 'Now'. *Texas Linguistic Forum*, 15, 60-69.
- Dummett, M. (1959) Truth. *Proceedings of the Aristotelian Society*, 59, 141-162. Reprinted in Dummett (1978) pp1-24.
- Dummett, M. (1973) *Frege: Philosophy of Language*, 2nd edition, 1981. London: Duckworth.

- Dummett, M. (1977) Can Analytic Philosophy be Systematic, and Ought it to Be?. In Henrich, D. (ed.) *Ist systematische Philosophie möglich? Hegel Kongress Stuttgart 1975, 1977*, pp305-326. Published in *Hegel-Studien*, Beiheft Nr. 17, Bonn. Reprinted in Dummett (1978) pp437-458.
- Dummett, M. (1978) *Truth and Other Enigmas*. London: Duckworth.
- Evans, G. (1981) Understanding Demonstratives. In Parret, H. and Bouveresse, J. (eds.) *Meaning and Understanding*, pp280-303. Berlin: de Gruyter.
- Evans, G. (1982) *The Varieties of Reference*. Oxford: Oxford University Press.
- Frege, G. (1884) *The Foundations of Arithmetic: A logico-mathematical enquiry into the concept of number*. Breslau: Koebner. Translation by J L Austin (1950). Oxford: Basil Blackwell.
- Frege, G. (1891) *Function and Concept*. Jena: Hermann Pohle. Translation by Peter Geach in Frege (1984) pp137-156.
- Frege, G. (1892) On Sense and Meaning. *Zeitschrift für Philosophie und philosophische Kritik*, 100, 25-50. Translation by Max Black in Frege (1984) pp157-177.
- Frege, G. (1984) *Collected Papers on Mathematics, Logic, and Philosophy*. Oxford: Basil Blackwell. Translation of the German collection *Kleine Schriften* edited by I Angelelli (1967) Olms, Hildesheim.
- Frege, G. (1918-19) The Thought: A Logical Investigation. *Beiträge zur Philosophie des deutschen Idealismus*, 1, 58-77. Translation by Peter Geach and R H Stoothoff in Frege (1984) pp351-372.
- Gazdar, G. (1979) *Pragmatics, Implicature, Presupposition, and Logical Form*. New York: Academic Press.
- Kamp, J. A. W. (1971) Formal properties of 'Now'. *Theoria*, 37, 227-273.
- Kamp, H. and Rohrer, C. (1983) Tense in texts. In Bauerle, R., Schwarze, C. and von Stechow, A. (eds.) *Meaning, Use and Interpretation of Language*, pp250-269. Berlin: de Gruyter.
- Kaplan, D. (1969) Quantifying In. In Davidson, D. and Hintikka, J. (eds.) *Words and Objections: Essays on the Work of W.V. Quine*, pp206-242. Dordrecht: D. Reidel.
- Kaplan, D. (1975) How to Russell a Frege-Church. *Journal of Philosophy*, 72, 716-729.
- Kaplan, D. (1977) Demonstratives: An Essay on the Semantics, Logic, Metaphysics and Epistemology of Demonstratives and Other Indexicals. Draft No2, UCLA xerox.
- Kaplan, D. (1979) On the Logic of Demonstratives. In French, P. A., Uehling, Jr., T. E. and Wettstein, H. K. (eds.) *Contemporary Perspectives in the Philosophy of Language*, pp401-412. Minneapolis: University of Minnesota Press.
- Kripke, S. (1972) Naming and Necessity. In Davidson, D. and Harman, G. (eds.) *Semantics of Natural language*, pp253-355. Dordrecht: D. Reidel.

- Levinson, S. C. (1983) *Pragmatics*. Cambridge: Cambridge University Press.
- Lewis, D. (1970) Anselm and Actuality. *Nous*, 4, 175-188. Reprinted with a postscript in Lewis (1983) pp10-25.
- Lewis, D. (1973) *Counterfactuals*. Oxford: Basil Blackwell.
- Lewis, D. (1983) *Philosophical Papers*, Volume 1. Oxford: Oxford University Press.
- Linsky, L. (ed.) (1971) *Reference and Modality*. Oxford: Oxford University Press.
- Lyons, J. (1977) *Semantics*. Cambridge: Cambridge University Press.
- McCawley, J. D. (1971) Tense and time reference in English. In Fillmore, C. and Langendoen, T. (eds.) *Studies in Linguistic Semantics*, pp96-113. New York: Holt, Rinehart and Winston.
- Montague, R. (1968) Pragmatics. In Klibansky, R. (ed.) *Contemporary Philosophy: A Survey*, pp102-122. Florence: La Nuova Italia Editrice. Reprinted in R H Thomason (ed.) (1974) pp95-118.
- Montague, R. (1970) Universal Grammar. *Theoria*, 36, 373-398. Reprinted in R H Thomason (ed.) (1974) pp222-246.
- Perry, J. (1977) Frege on Demonstratives. *Philosophical Review*, 86, 474-497.
- Perry, J. (1979) The Problem of the Essential Indexical. *Nous*, 13, 3-21.
- Quine, W. (1943) Notes on Existence and Necessity. *Journal of Philosophy*, 40, 113-127.
- Richards, B. (1982) Tense, aspect and time adverbials I. *Linguistics and Philosophy*, 5, 59-107.
- Richards, B. (1986) Tenses, temporal quantifiers and oblique contexts. In Lepore, E. (ed.) *The Philosophy of Donald Davidson: A Perspective on Inquiries into Truth and Interpretation*. Oxford: Basil Blackwell.
- Russell, B. (1903) *The Principles of Mathematics*, 2nd edition, 1937. London: George Allen and Unwin.
- Sag, I. A. (1981) Formal Semantics and Extralinguistic Context. In Cole, P. (ed.) *Radical Pragmatics*, pp273-294. New York: Academic Press.
- Scott, D. (1968) Advice on Modal Logic. In Lambert (ed.) *Philosophical Problems in Logic*. Dordrecht: D. Reidel.
- Smullyan, A. F. (1948) Modality and Description. *Journal of Symbolic Logic*, 13, 31-37. Also in Linsky (ed.) (1971).
- Taylor, B. (1977) Tense and continuity. *Linguistics and Philosophy*, 1, 199-220.
- Thomason, R. H. (ed.) (1974) *Formal Philosophy: Selected Papers of Richard Montague*. New Haven, Conn.: Yale University Press.
- Tichy, P. (1980) The logic of temporal discourse. *Linguistics and Philosophy*, 3, 343-369.

- Tichy, P. (1980a) The semantics of episodic verbs. *Theoretical Linguistics*, 7, 263-296.
- Tichy, P. (1985) Do we need interval semantics? *Linguistics and Philosophy*, 8, 263-282.
- van Inwagen, P. (1980) Indexicality and Actuality. *Philosophical Review*, 89, 403-426.
- Wallace, J. (1972) Belief and Satisfaction. *Nous*, 6, 85-95.